No. 8. — *Studies of the Jelly-fishes of Narragansett Bay.* By J. Walter Fewkes.

The following pages contain an account of certain new *Acalephæ* collected by me during three summers' work at Newport, R. I.,* with notes, anatomical and embryological, on those which have been previously known. A few jelly-fishes are also described from drawings and notes made by Mr. Alexander Agassiz, since 1865, at Newport and Naushon. These are mentioned in the appropriate places under the respective medusæ.

HYDROIDA.

Sarsia mirabilis, Agassiz.

Plate III. Figs. 11, 12.

S. mirabilis is rarely found in Narragansett Bay. During the summer months which were spent in Newport, only two specimens of this jelly-fish were found. If one contrasts this rarity of the medusa south of Cape Cod with its abundance at times in the waters of Massachusetts Bay, the conclusion seems evident that the specimens which were captured in the former locality were stragglers, and do not strictly belong to the fauna of Narragansett Bay. A portion of the base of the tentacle of *S. mirabilis* is specialized into a spherical body, which projects downwards as the jelly-fish swims in the water, hanging below the margin of the bell.

The walls of this spherical enlargement at the base of the tentacle are formed of two layers, and enclose a number of cellular bodies, which resemble indistinctly lasso cells. They appear to have some special function, and are not found in other genera of our coast closely related to *Sarsia*. Covering the surface of the walls in which they are contained, there are many small, bright red pigment dots. The true eye-spot (ocellus) is black, and is mounted on a papilla, which rises on the upper and external side of the base of the tentacle. The spherical enlargement previously mentioned is on the under and opposite side of the base of the tentacle. A figure to illustrate the general appearance of the tentacular bulb, with the two structures, ocellus and problematical sense organ (*spherical body with contained cells*), is given, with an enlarged view of part of the latter structure, in Plate III. figs. 11, 12.

* I am indebted to Mr. Agassiz for facilities to carry on this work in his private laboratory, at Newport, R. I.

Lizzia grata, A. Ag.

Plate I. Figs. 1, 2, 3, 4, 5, 6, 7.

Sars * described, many years ago, a jelly-fish closely allied to *L. grata*, which he named *Cytæis octopunctata.* Forbes † refers to this jelly-fish of Sars a form from the coast of England, which he called *Lizzia octopunctata. Lizzia grata*, first described from our waters by Mr. Agassiz, is closely allied to *L. octopunctata.* While in the figures which Forbes gives of *L. octopunctata* there are but two tentacles in each of the clusters midway on the bell rim between the radial tubes, in the jelly-fish which I had there were three, as is represented (Plate I. fig. 1). Forbes, however, in his descriptions, speaks of specimens in which there were three members in the cluster as well as two, mentioning it, however, as if rather after the nature of an abnormality. Three is the normal number found in well-developed animals, and none were taken in which it was exceeded, however far advanced the medusa had grown. The number of tentacles, however, from the ocellus of the radial tubes, as Mr. Agassiz figures is, in large specimens, five or six. Forbes, on the other hand, says that in *L. octopunctata* only three tentacles arise from the radial ocellus. (See Naked-eyed Medusæ, Plate XII. figs. $3 - 3_2$.)

The adult and several of the younger stages of *L. grata* have been described in the "North American Acalephæ," by Mr. Agassiz. The process of budding from the proboscis is mentioned by him in a paper before the Boston Society of Natural History, in 1862 (p. 100, Figs. 28, 29).

Haeckel ‡ has formed a new genus called *Margellium* for the reception of the *Lizzia octopunctata* of Forbes and *L. grata* of A. Agassiz, and looks upon each as a separate species. In his diagnosis of Forbes's species, Haeckel makes no mention of the fact spoken of by Forbes, that the number of tentacles in the intermediate cluster is sometimes three. This is rather astonishing, as Haeckel considers the supposed inequality in the number of tentacles in different clusters a generic characteristic. Haeckel also suggests the genus *Rathkea* for Lizzia-like jelly-fishes, in which the number of tentacles in radial and intermediate clusters is equal. The young *Lizzia* resembles so closely the proposed genus that at least new characters must be pointed out to distinguish the two.

The *Oceania Blumenbachii* described by Rathke, and which suggested the new genus *Rathkea*, which Haeckel proposes, has eight clusters of tentacles with generally two members in each cluster. Rathke gives in his figure of *O. Blumenbachii* eight chymiferous tubes, an interesting condition, of which I shall speak in considering a new genus which I have called *Mabella.* Four of these tubes in Rathke's medusa are regarded by Haeckel as foldings, the result of muscular action in the bell walls.

* Wiegm. Arch. 1837, Part V. p. 406, and Fauna Littoralis Norwegiæ.

† Naked-eyed Medusæ.

‡ Das System der Medusen, Erster Band, p. 95.

Sars gives a good account of the process of germination in *L. octopunctata.* This description applies also to *L. grata*, but he was not able to trace the medusa up to what I believe is its adult. The oldest *Lizzia* which Forbes figures is also immature. My account of the sequence in the development of the tentacles is different from that which Mr Agassiz gives (Proc. Bost. Soc., 1862).

L. grata was found in abundance at Newport during all the summer months. Its small size and transparent bell would render it inconspicuous, if not invisible, were it not for the eight black pigmented ocelli on the bell margin at the bases of the tentacles. Four of these ocelli are situated near the point where the radial tubes join the margin of the bell, and four on the bell rim midway between the radial vessels.

The bell is deep, campanulate, and in older specimens has a pointed apex. The surface is smooth in the adult, and destitute of papillæ. The relative size of all the organs can be seen by a study of Plate I. fig. 1. The line at the left of the figure indicates its size. The proboscis is never, except when the bell is abnormally reversed, extended outside of the bell opening, but it generally reaches down about half of the whole height of the bell cavity. The stomach is mounted upon a peduncle, which resembles the substance of the bell walls in its transparency. The chymiferous tubes are small, simple, and without lateral glands or appendages. They are four in number, and, extending along the sides of the pedunculated proboscis, open into the stomach. Near this termination the peduncle bears a cluster of peculiar cells.

The stomach is four-sided, with oral tentacles which impart to it a cruciform shape when seen from below. The extremity of each oral tentacle is bifid, and the end of each bifurcation is thickly covered with many small cells or pedunculated knobs. Near the bifurcation of the oral tentacles from the axis of the proboscis are also similar clusters of knob-like organs of smaller size than those mentioned. The tentacles are short, very flexible, hollow, uniform in size, and with smooth surfaces. They are arranged in eight clusters, which in most stages of growth have an inequality in the number of component tentacles. The junction of each cluster with the bell margin forms a triangular bulb or ocellus, which in the adult is dark brown and black.

There are no otocysts on the bell margin. Claparede was unable to find the male of the *Lizzia* which he studied. Forbes mentions the male *Lizzia* as larger than a female, with the attached buds. Mr. Agassiz figures a male of *L. grata*, and calls the sexual structure near the base of the proboscis "sexual sacs." I have observed large *Lizzia* which were females, in which the power of germination seemed to have ceased, or to have become dormant, although from the proboscis of the same medusa young had previously formed by budding. A *Lizzia* in this condition may have been called a male by Forbes and Agassiz. The essential elements of the male were not detected in *L. grata.* It would be a very interesting fact to determine whether *Lizzia* lives for any length of time after the process of germination from the proboscis has ceased, and, if such is the case, whether true ova and spermatozoa are then developed as final products of the same process. From the observations which were made bearing on this question, it seems probable that the egg in *Lizzia* is always produced after the budding of the young has ceased. As a preliminary to the whole question, it must first be determined whether *Lizzia* has a fixed hydroid or not.

The observation of the egg of *Lizzia* by Claparede,* who described it as passing through a direct development, should not be dismissed as an error, in the summary way it has been by many naturalists. The egg enclosed in a capsule, which he figures, and which he says develops directly into a medusa, was probably the last product of this process of budding, which opened with the production of a jelly-fish by a sexual gemmation.

The growth of the bud of a young *Lizzia* from the proboscis of the parent is as follows.

Plate I. fig. 1 represents a moderately large *Lizzia*, which, however, is not an adult, where the number of tentacles in radial and intermediate clusters is the same. In this figure, on the left-hand side of the upper part of the proboscis an attached medusa bud, considerably developed, can be seen. The shape of the bud is about spherical, and it is united to the proboscis by a short, thick peduncle, through which passes a tube forming a free communication between the stomach cavity of the parent and the half-formed proboscis of the young. The surface of the bell, as that of all the other younger buds which are figured, is covered with minute papillæ. The contractions and expansions of the budding bell, even while still attached, are quite rapid and violent, causing the animal to sway back and forth as the water emerging from the opening of the bell strikes against the inner walls of the bell cavity of the parent. The cavity of the bell of the young is relatively much larger than that of the adult. The whole of its apex is taken up by a short pedicle, by which, as has been already pointed out, the bud is fastened to the parent.

The number of tentacles appended to the bud in this stage of growth is sixteen. The same number is also found in the youngest of the free forms, which had voluntarily separated from the parent, and were fished up with a drag-net. These tentacles are distributed as follows. At the end of each tube there is a cluster of three tentacles, composed of a medial member, usually the longest, and two lateral. A single short tentacle is placed in a position midway on the bell rim between each of these clusters. The tentacular bulbs in the bud as compared to the bell are larger in the bud than in the adult. The proboscis has a yellow color, and is, like that of the adult, already four-parted, and when seen from below is cruciform. The extremities of the oral tentacles are undivided, but bear many small knobs mounted on short thread-like styles. The proboscis has as yet no peduncle. The stomach and oral tentacles resemble closely the same organs of *Dysmorphosa*. Three buds on the proboscis of this bud belong to a second generation, grandchildren of the original *Lizzia* with which our account opened. The second generation of buds has not been found

* Zeit. f. Wiss. Zoöl., Bd. X. p. 403.

by me very completely developed, as long as the union of their parent to the first *Lizzia* remained unbroken. In addition to a well-developed bud, which, as Sars pointed out, seems in its growth far in advance of the remainder, we find other buds, now to be described, in various stages of development, from a simple hernia-like protuberance of the walls of the proboscis to a sphere united at one pole to the parent. Each seems in its early stages to be enclosed in a separate capsule, which is ruptured at the time when the bell opening is formed, long before the final separation of the bud from its parent. The remains of the capsule after the rupture are then absorbed by the parent. In the youngest buds from the proboscis of a *Lizzia*, four of the tentacular bulbs are very large and conspicuous. These bulbs are situated at the junction of radial tubes, with a circular vessel. From each of them arises a single club-shaped and hollow tentacle, which, with the three other primary tentacles, is nicely folded over the future opening of the bell cavity above the future veil. In this stage, before the capsule in which the young medusa is contained is ruptured, the four tentacular bulbs, which become the ocelli, are large, and form the most conspicuous structure in the bud. In the same stage the proboscis is a club-shaped body, almost filling the whole upper part of the bell cavity, and has the free end bifid, thus prophesying the future oral tentacles. Each of the bifurcations is thickly set with lasso-cells, but is destitute of knob-like bodies mounted on pedicles. The mouth is as yet closed. The next oldest stage to that last described in the growth of the bud is one in which there are four radial tentacles, and the beginnings of four others intermediate between them on the bell margin. This stage resembles in many particulars a jelly-fish called *Dysmorphosa fulgurans*, A. Ag. We have here eight tentacles, of unequal size to be sure, and buds beginning to form on the proboscis, both true characteristics of *Dysmorphosa*. A little later the surrounding capsule breaks, and the bell opening, with its veil, is speedily formed, so that there protrudes a well-developed medusa, only a little less mature than that shown in Plate I. fig. 1.

The order of appearance of new tentacles in the intermediate clusters is different from that given by Mr. Agassiz,* and copied from him by Haeckel.† The method of growth, more especially the addition of the new tentacles, is as follows.

The tentacles in the intermediate clusters appear *singly*, each one of its cluster being well developed before the beginning of the next following. Good figures of *Lizzia*, while in a stage with two tentacles in each intermediate cluster, and at the same time with three in the radial clusters, are given by Forbes. In fact a medusa with tentacles in this condition is the oldest which he has figured. It is probably, as has been pointed out, a younger stage, for in subsequent growth a third tentacle is added to each interradial cluster, and thus we have a medusa in which the number of tentacles is three in all clusters,

* North American Acalephæ, p. 161.

† Das System der Medusen, p. 95.

both intermediate and primary, although the tentacular bulbs at the ends of the radial tubes are larger than the remainder. This predominance in size they always retain. Fig. 1, Plate I., represents a young *Lizzia*, intermediate in form between that figured by Forbes and the adult *L. grata* as given by Mr. Agassiz. The addition of two more tentacles to the primary clusters completes the number five and gives for the adult, as far as followed by any observer, thirty-two tentacles in all. There appears, however, no satisfactory evidence that this is the maximum number possessed by the adult, and possibly the intermediate clusters likewise increase to five tentacles instead of three, which would give it a resemblance to the genus *Rathkea* of Haeckel.

Lizzia passes through a *Dysmorphosa* and *Margellium* stage, and has the power of germination throughout them both. It seems, therefore, hardly proper as yet to form new genera, as Haeckel has done, on what are surely embryonic features. The genus *Rathkea* of Haeckel, or *Oceania Blumenbachii* of Rathke, in the description and figures of the latter, has eight chymiferous tubes. I do not feel justified in considering with Haeckel that four of these tubes are folds of the bell or muscular fibres. There is one feature found only in more advanced stages, which seems to be wanting in all the immature conditions of the *Lizzia*. Four small bundles of oral knobs are formed on the under side of the lips near the bifurcation of the oral tentacles. These make their appearance at the same time that the second tentacle in the intermediate clusters develops. Mr. Agassiz has given a good figure of them in the adult proboscis (N. Amer. Acal., p. 162).

The specimens of *Lizzia*, with buds in all sizes, which I have studied, were taken abundantly in tide eddies in Laboratory Cove, at Newport, R. I. The development of the egg is unknown. At the junction of each of the radial tubes with the stomach, in older specimens, clusters of small ovarian-like cells were observed, which resembled undeveloped ova, but I was unable to definitely form an opinion as to their exact character.

Mabella gracilis, n. g. & s.

Plate VI. Figs. 2, 3.

A single specimen of a very interesting jelly-fish was taken near the close of the month of July. This medusa is of a genus as yet undescribed, and resembles *Dysmorphosa* very closely, with the exception (?) that it has *eight* radial chymiferous tubes. Gemmation from the proboscis similar to that which has been described in *Lizzia*, combined with the last-mentioned characteristic, makes it a most interesting and exceptionable jelly-fish. The bell has the shape of a very convex watch-crystal, the height of which is about one half its radius. It is transparent, colorless, and the surface is covered sparsely with small papillæ. The chymiferous tubes are narrow, without side appendages, simple, and *eight* in number. Proboscis without a peduncle, quadrate, with four undivided and non-bifurcated oral tentacles, which have their club-shaped tips covered with knobs not unlike those in *Lizzia*. The mouth is never protruded beyond the bell opening. There were three half-formed buds on the walls of the upper part of the proboscis, but none were far enough developed to exhibit movements of themselves, and appeared to be enclosed in a capsule. Tentacles hollow, flexible, transparent, sometimes carried upright as in Fig. 3, are about equal length, and with smooth surfaces. Number of tentacles eight. The tentacular bulbs are divided into two parts, an external portion so called, since more distant from the centre of the disk than the other, is carried external to the bell cavity as the jelly-fish swims, and is of dark brown color. A smaller, internal part of crimson color may be likened to a true ocellus. Sexual organs not known. Hydroid unknown. This genus is the only one described in which budding takes place from the proboscis of a hydroid medusa with *eight*, or more than four, chymiferous tubes. It resembles closely *Dysmorphosa fulgurans*, A. Ag.

I feel sure from repeated examination that *Mabella* has eight tubes in the bell, but cannot definitely say that it is not the same as *D. fulgurans*, A. Ag. Brandt * represents in *Rathkea Blumenbachii* a jelly-fish with eight tubes, but the tentacles in it are not single, and no reference is made by him to gemmation from its proboscis as a method of reproduction. The shape of the bells of *Rathkea Blumenbachii* and *M. gracilis* is very different, which leads me to think that these two medusæ, although alike in the number of chyniferous tubes radially arranged in the bell, are not the same.

Turris episcopalis, Fewkes.

Oceania episcopalis, Forbes.

Plate III. Figs. 1, 2, 3, 4, 5, 6.

Several specimens of a jelly-fish, which seems to be identical with the *O. episcopalis* of Forbes, were taken by me last summer. These medusæ were all found in the same week in July, and at no other time. In former seasons it has not been seen. The whole number of specimens taken was ten. This medusa is one of the largest of the Tubularians of our waters, and is inferior to none in beauty. The positions which it assumes while swimming are very characteristic and full of grace. The bell is shaped like an inverted teacup, with a conical prolongation above. This projection may be retracted into a spherical shape, or greatly elongated into a slender cone. In some specimens the cone is capped on the apex by a small button. The prolongation is gelatinous and solid, with smooth surface. The walls of the bell itself are thin, transparent, pale milky white. The radial tubes are very broad with lateral glands (?) or muscular attachments to the bell walls, imparting to their outline a jagged appearance. Number of radial tubes four. Circular tube broad,

* Brandt, Beschreibung der Oceania Blumenbachii einer bei Sevastopol gefundenen leuchtenden Medusa von H. Rathke, 4 Oct., 1833.

with a jagged upper edge, as seen in profile. All the tubes infested with parasitic *Distoma*. The proboscis is large, hanging from a pyramidal elevation in the bell cavity left by four recesses, which are prolongations of the bell cavity itself, extending into the base of the apical extension of the bell walls. The broad tubes which extend along the proboscis hang from this projection as in a sling, one from each angle. The prolongations of the bell cavity upward into the gelatinous substance of the conical apex of the bell leave four thick partitions, which separate the upper bell cavity into four chambers. These chambers can best be understood by a study of the figures (Plate III. figs. 1, 2, 3, 4). The sexual organs were fully developed, and in all the individuals which I captured were female. The ovaries in larger specimens were swollen with ova, and are formed of vertically placed tubes flanked with lateral branches, which, when the ovaries are mature, fill almost the whole upper part of the bell cavity below its division into the four chambers already mentioned. The stomach is quadrate in shape, with mouth simple, and destitute of oral tentacles. The proboscis terminates near the veil, and rarely, except in distorted specimens, extends outside the bell opening.

There are two kinds of tentacles, the smaller of which probably develop into the larger. The length of these two kinds of tentacles is very disproportionate. The ocelli placed upon their respective bases seem to be arranged in two series, those on the bulbs of the longer tentacles are situated higher up on the bell than those on the smaller. The long tentacles in the oldest specimen, which I have studied, are very flexible, and when retracted are closely coiled together, each one around its respective tentacular bulb. The number of long tentacles is sixteen. In the young specimen of *O. episcopalis*, Forb., which Forbes figures, there are but eight long tentacles. Four arise from the point of junction of radial and marginal tubes, and three on the bell rim between each pair of the primary tentacles. All sixteen long tentacles have triangular enlargements at their bases, and are joined by one angle of the enlargement to the bell margin, while the adjacent angle is continued into a pointed projection, extending upward for a short distance along the side of the bell, as shown in Plate III. fig. 5. At the very tip of this extension there is a bright crimson pigment spot. There are sixteen of these pigment spots, and together they make the upper series. They are true ocelli, corresponding with the black eyespots on the tentacular bulbs of *S. mirabilis*, Ag.

Between every pair of these larger tentacles, there are three short, fingerlike processes, each with a single pigment spot at its base, the color of which is the same as that of the pigment spots of the upper series. The centrally placed of these three short tentacles is the most developed, and the pigment spot which it bears is of about the same size, and has the same appearance, as those of the upper series. None of the smaller tentacles send a pointed projection from the tentacular bulb up the side of the bell, as is the case with all the long tentacles. There are forty-eight smaller tentacles. The pigment spots which they carry form the second and inferior series of these organs. The tentacles, both large and small, are hollow, flexible, and with smooth surfaces. Their color is pale yellow. In the youngest stages each pigment spot is double, formed of two clusters of pigment grains of unequal size.

Plate II. fig. 2, in Forbes's work, illustrates a young specimen of this species. Figs. 3 *b*, 3 *c*, of the same plate, exhibit very well the arrangement of the pigment spots of the tentacles in two series. In Plate III. fig. 2, I have given for comparison a younger stage of this genus, with eight long tentacles. The bell is not relatively as high as in Forbes's figure of the same, and the four prolongations of the bell cavity into the apical projection of the bell are more pointed and deeper than he has represented.

Development from the egg is unknown.

Locality, Newport, R. I.

Turris episcopalis seldom comes to the surface of the water, in the glass vessel in which it is confined, and may be a deep-sea medusa. It seems to be very near the medusa which Claus described as *Oceania pileata* (Zeit. f. Wiss. Zool., Bd. XIV., Stud. über Polypen und Quallen der Adria. Taf. XIII. figs. 46, 47).

Modeeria multitentacula, n. s.

Plate III. Figs. 7, 8, 9.

A jelly-fish found by Mr. Agassiz, in 1865, resembles closely the genus *Modeeria*, Forbes, as he has pointed out in manuscript notes from which this description was made. It differs from *M. formosa* in the following particulars. Its bell is of uniform thickness, while in *M. formosa* the apex is much thicker than the walls. The chymiferous tubes of *M. multitentacula* are broad and well defined, while in *M. formosa* they are fine and thread-like. The peduncle upon which the stomach and ovaries are borne is much more developed than in *M. formosa*. The tentacles are more numerous in *M. multitentacula* than in *M. formosa*, and the pigment spots of the tentacular bulbs are found on their under surfaces at a short distance from the union of tentacles and bell margin. The medusa resembles the genus *Callitiara*, Haeck. *M. formosa* has undeveloped ovaries, and may be the young of a form more like *M. multitentacula*.

The bell of *M. multitentacula* is high, almost a prolate spheroid in form, with one pole truncated to form the bell opening. The diameter near the bell margin is slightly greater than that just above this point. It decreases very gradually towards the apex, where it is only a trifle less than at the bell margin. The bell walls are thin throughout, and without apical prolongation or thickening. Chymiferous tubes simple, with smooth profile, and of medium width. They enlarge slightly before their junction with their tentacles, and are four in number. In the upper part of their course they arch over on to the peduncle, and extend down the sides of the proboscis to their opening into the stomach. Bell transparent, and with smooth surface.

The proboscis is large, with a peduncle, which fills a large part of the upper portion of the bell cavity, and extends downward almost to the bell opening.

The mouth rarely reaches outside the entrance into the bell cavity. The peduncle in the figure has a cellular appearance. This resemblance to cells may be due simply to superficial folding of its walls, and the peduncle itself may be transparent and gelatinous, like the remainder of the bell from which it hangs.

The sexual organs are formed of four globular bodies, of orange brown color in which darker colored patches are distinguishable. The specimen figured is a female. The male is unknown. The oral tentacles are simple, short, four in number, and clothed at their tips with many knobs.

The tentacles are numerous, uniform in size, flexible, hollow, carried like those of *Trachynema* or *Turritopsis* closely coiled about their bases. Their color is greenish, with deeper coloration in the bulbs. Tip of the tentacle pink. Number of tentacles, thirty-two.

A bright crimson pigment spot is borne on the under side of the enlarged base of the tentacle, a short distance from its union with the rim of the bell. This position of the pigment spot is very characteristic.

Development from the egg unknown. Male unknown.

Locality, Naushon, Buzzard's Bay. A. Agassiz.

This jelly-fish I have never seen, and the description is made from a sketch, with notes loaned me for that purpose, by Mr. Agassiz.

Gemmaria gemmosa, McCrady.

Plate I. Figs. 10, 11, 12.

McCrady first described a new jelly-fish from Charleston Harbor allied to *Zanclea* of Gegenbaur, to which he gave the name of *Z. gemmosa*, suggesting at the same time that its characteristics may be important enough to place it in a new genus for which he presents the name *Gemmaria*. Mr. Agassiz adopts the name *Gemmaria gemmosa*, and gives additional drawings of what seems to have been the same jelly-fish. The form which is here described as the adult of *G. gemmosa* was discovered by Mr. Agassiz, from whose drawings and notes this description is made.

The bell is teacup-shaped, with an apical hemispherical protuberance, which rises slightly above the apex. The bell walls are thin. Surface, except in four meridional lines yet to be mentioned, smooth. The radial tubes simple, narrow, smooth in profile, and four in number. Proboscis without peduncle, and extending normally to the opening into the bell cavity, and sometimes capable of great protrusion outside the bell. Oral tentacles wanting. The mouth opening is circular. The lips are studded sparsely with large lasso-cells. The lower part of the proboscis is slender, the upper very much swollen with the ovarian glands. Ovaries in four spherical lobes, through the walls of which eggs with germinative dot and vesicle can be plainly seen.

The tentacles are primary, uniform in size and length, and four in number. The tentacular bulbs are large, and each tentacle is thickly crowded with tentacular knobs, which resemble stalked capsules, in each one of which is contained a number of lasso-cells (?). The knobs near the end of the tentacle are more scattered. The surface of the tentacle is rough. Four meridional lines or areas extend from the tentacular bulbs along the surface of the bell to its apex. To these structures, which are filled with bright cells, the species owes its name. I am in doubt whether they are continued the whole distance to the apex. Near the bulbs of the tentacle they form four areas, broader than the meridional lines, and otherwise differentiated from them.

The otocysts are wanting.

Locality, Newport, in September.

The genus *Gemmaria*, if this form with four tentacles is the adult, is closely allied to *Zanclea* of Gegenbaur.

Dinematella cavosa, n. g. & s.

Plate II. Figs. 2, 3, and Plate IV. Fig. 3.

Many specimens of a jelly-fish closely allied to *Stomatoca apicata* were taken in the summer of 1880. This medusa has generally been confounded with *S. apicata*, being looked upon as a variety, or as its male.

The most striking superficial difference between the two genera is in the color of the ovaries, and their peculiar shape. Mr. Agassiz mentions in "North American Acalephæ" examples of *S. apicata* where the sexual organs are cream-colored. He may have had the same medusa which is here described, and which is considered a wholly different genus from *Stomatoca*. The most important anatomical peculiarity of this new genus is the presence, in the apical prolongation of the bell, of a cavity, which almost fills the whole of this part. The bell has a conical apical projection which is not as high as a like protuberance in *Stomatoca*. The height of the projection is not more than one half that of the bell itself. In young specimens it is very small. The cavity within occupies all the lower part of the projection, and has a form which would contain the frustum of a cone. The contents of the cavity is a liquid identical with that which circulates in the marginal and radial tubes. A similar cavity in the apical prolongation of the bell in *Ctenaria* is said by Haeckel to contain planulæ. It is hardly possible in alcoholic specimens to distinguish the planulæ of *Dinematella* from particles of chymiferous fluid. The cavity in the apical projection of this genus is not a brood sac, and has not been observed with young medusæ within. The extremity of the prolongation on the apex of the bell is *solid*, forming a gelatinous hemisphere without external opening, which caps the top of the cavity. In a younger specimen, the walls of this cap were penetrated by a tube, through which, when attached to the hydroid, their cavities probably communicated. *Dinematella* probably buds from a hydroid, and this cavity never serves as a brood sac, at least for stages more developed than the planula. In older specimens there is no communication between the cavity and the surrounding medium, as in *Ctenaria*. The color of the bell is light green.

The radial tubes are unbranched, broad, with jagged profile, and four in number. The proboscis is shorter than that of *Stomatoca*, and extends two thirds the distance down the bell cavity. There is no peduncle. The ovaries are large, and crescentic shaped, filling a large part of the upper portion of the bell cavity. They are of a cream color, with a greenish tinge. Oral tentacles not folded, and undivided, without knobs, and four in number. At times the oral tentacles by a contraction of the bell walls are extended beyond the bell opening, as is also the case in *S. apicata*. Veil thick, muscular, and when at rest re-entering the bell cavity. It plays a great part in the motion of the animal. Tentacles two, very long and flexible, and at times coiled into a shapeless snarl around the tentacular bulb. Their color is light green, with extremities white. Tentacular bulbs large, pale green, and cream-colored, in the motion of the medusa carried sidewise like those of *Stomatoca*. Their color, as that of the whole tentacle, is often tinged with pink. Between the two long tentacles in either semicircle of the bell margin there are three slight projections, each one of which has a bright pigment spot of crimson color. The pigment spots are not borne on small tentacles, as in *Stomatoca*, but on simple protuberances.

Otocysts wanting.

Development unknown. Eggs small, white, cast in great numbers in the glass dish in which the jelly-fish is confined.

Locality, tide eddies in Laboratory Cove, Newport, R. I. Many specimens were taken each summer.

Stomatoca apicata, Agassiz.

Plate II. Figs. 1, 4, 9.

This beautiful jelly-fish was first described by McCrady, under the name of *Saphenia apicata*. It differs very greatly from *S. dinema* of Eschscholtz and Forbes in the shape of the bell, as compared with the figure given by the latter. Eschscholtz gives no figure of *S. dinema*, and, until a comparison of specimens can be made, it is best to retain the specific name of *apicata* for our representative of the genus.

The only published figure of *S. apicata* is a poor one by McCrady. A similar jelly-fish was mentioned by Mr. Agassiz, from New England waters, but he has given no figures of it, and added nothing to McCrady's account.

The bell has an irregular, triangular profile, and the upper angle is formed by a conical projection, apically placed, the height of which is oftentimes double that of the bell itself. This prolongation varies in size in different specimens, now very slender, and then short and blunt. It may also be at times, as McCrady says, jauntily carried on one side. The substance of the apical projection is solid throughout. The bell walls are thin and with smooth surface. The diameter of the bell is slightly larger near the margin than a little above. The chymiferous tubes are broad, with jagged outline, and are four in number. Near their junction with the two tentacles they enlarge into small triangular cavities. The stomach is capacious, and without peduncle. It is very extensile, the lips normally falling outside the bell opening, but also at times retracted into the cavity of the bell. The upper part of the bell cavity is almost wholly taken up by large ovaries, which cover and conceal the whole base of the proboscis. The ovarian glands are formed by four spherical lobes of claret color, the surface of which resembles closely the convolutions of the brain. The eggs are cast in abundance by the larger females, and were raised into planulæ. They are white in color, and undergo a total, regular segmentation. I have not traced them into a hydroid, but have no doubt that they ultimately develop into that condition.

The lower part of the proboscis is slender, and enlarges into a trumpet-shaped mouth. The walls which separate the lobes of the ovaries are continued into the lips as four elevated ridges, which give to the stomach, when seen from below, a cruciform shape. The lips of the trumpet-shaped mouth are very much folded, and are destitute of lasso-cells or knobs. The medial line of the lower and slender portion of the proboscis is of a claret color, which fades gradually in the raised ridges into brown and pale red. There are two tentacles, both of which are very long and flexible, and of equal size. At rest they are generally coiled up into a snarl about the tentacular knobs. Their color is white. Between the long tentacles in either hemisphere of the bell margin there are seven tentacula-like bodies, each one with a claret-colored pigment spot, resembling in size and color an ocellus. McCrady speaks of three of these pigment structures, or ocelli, but does not figure them in his plate. The tentacula-like structures which arise from the margin of the bell near the radial tube, intermediate between the longer tentacles, are larger than the others. The size of all, as compared with the two long tentacles, is very small.

S. apicata is common at Newport, and, like many other jelly-fishes, it seems to prefer the bottom of the aquarium in which it is confined, and only rarely comes to the surface of the water.

Turritopsis nutricola, McCrady.

Plate IV. Figs. 4, 7, 8, 9, 10.

The genus *Turritopsis*, first suggested by McCrady, is well known on account of the peculiar life of the young *Cunina octonaria*, McCr. in its bell cavity. The only description which we have of the adult is by McCrady, but the distinguishing points in its structure were not sufficiently emphasized by him, and especially in the account of the base of the proboscis his description is quite faulty. The commensalist in the bell cavity of the jelly-fish from Charleston Harbor I have never seen. *Cunina octonaria*, its adult, is not found in Narragansett Bay. *Cunina discoides*, s. n. is, however, often taken, and its young may be a commensalist in some other medusa, but finds no protection in the bell of our *Turritopsis*. The bell of the adult *T. nutricola* has an almost spherical shape, with thin walls and a slight apical projection. McCrady's figures do not show this protuberance, for the reason that the specimens which he drew had the proboscis more or less protruded outside the bell cavity. The external surface of the bell in the adult is smooth, and in the young is crossed by eight meridional lines of cells, two of which arise from each tentacle and extend to the pole of the bell, where all have a common junction. The radial tubes are narrow, thread-like, and not "wide," as McCrady says. They are four in number. The proboscis is without peduncle. McCrady gives a long description of what he calls a cellular upper portion of the proboscis, which resembles a peduncle as found in some other medusæ. This cellular structure is in reality the inverted upper part of the bell cavity of a *Turritopsis* in which the proboscis has been extended outside the bell opening. The bell of this genus is often reversed, so that the whole of the proboscis with attached ovaries is pushed out exterior to the bell, just as takes place in other genera, as *Eucope* and *Obelia*. As a result of this protuberance of the proboscis, the upper part of the bell is infolded and pressed into a "cellular body," like a peduncle. In normal positions of the medusa the proboscis has no such peduncle.

The ovaries are large, and arranged in four lobes, which cover the whole upper part of the proboscis. Their color is orange. Of oral tentacles there are four, each one of which is subdivided into two parts at the extremity, and covered with very peculiar knobs, mounted on short retractile, thread-like pedicles. These knobs, as McCrady pointed out, give to the extremity of the oral tentacle a "frosted appearance." They are characteristic in their form of the genus *Turritopsis*. A few of the same kind of pedunculated cells are found near the first bifurcation of the oral tentacles, but the most of them are confined to their extremities. The tentacles are numerous, with a length twice the height of the bell, hollow, flexible, and clavate at their extremities. When at rest they are coiled around the base, not unlike the position assumed by the tentacles of *Trachynema digitale*, A. Ag. The number of tentacles in the oldest specimen is thirty. The tentacular bulbs are so closely crowded together that intermediate sections of the margin of the bell cannot be seen, or are so very small that the tentacular bulbs appear to touch each other.

Otocysts wanting.

Locality, Newport, R. I.

I have not noticed in the jelly-fish the zigzag motion which is mentioned by McCrady, but the movement was always direct, consisting of several successive rapid contractions of the bell and veil, and then a pause followed at a short interval by similar exertions. McCrady says *Turritopsis* is gregarious. It is found accompanied by large numbers of the same kind, but cannot be said to be more gregarious than many other jelly-fishes. Accumulations of many in one place are due to tide eddies.

The younger stages in the growth of the medusa have been well figured by Mr. Agassiz. A few intermediate stages are given by me to fill up the gaps in the developmental history (Plate IV. figs. 4, 6, 7, 9, 10). Fig. 6 is a magnified view of one of the peculiar knobs found principally on the extremities of the oral tentacles, and characteristic of the genus.

The development of the egg of *Turritopsis* is unknown. Eggs were observed to be dropped in August. The younger stages of the medusa are characterized by the tenuity of the bell walls, and the short tentacles, which are sometimes carried stiffly thrown back along the side of the bell or tightly coiled round the tentacular bulbs.

Dipurena strangulata, McCrady.

Plate IV. Fig. 5.

Two species of *Dipurena*, *D. strangulata* and *D. cervicata*, were described from Charleston Harbor by McCrady, who founded the genus. A third species, *D. conica*, is described from Naushon, Vineyard Sound, by Mr. Agassiz.

A single specimen of *D. strangulata* was captured by the author at Newport, in September. The bell is half-egg-shaped, with the minor axis greater than the height. It is very transparent, colorless, and has a smooth surface. Radial tubes four, resembling fine lines on the bell, and simple in profile. Proboscis long, slender, extending when protruded far outside the bell opening, and with ovaries so distended with eggs that it can with great difficulty be withdrawn into the bell cavity. At the point on the inner surface of the bell from which it is suspended, there is an enlargement in the neck of the proboscis into a kind of bulb, which has bright red contents. The function of this bulb is not known. A similar structure, reduced in size, is found in many other medusæ, as in *Sarsia mirabilis*, *Ectopleura ochracea*, and some others. The sexual organs are divided into two parts, or arranged in two packets on the proboscis, separated by an interval from each other. The upper of these is placed about midway between the bulb already mentioned and the mouth or the distal end of the proboscis. This division of the sexual organ is a simple oblong body of uniform size throughout. Through the external walls the motion of the chymiferous fluid within the proboscis can be well seen. The enlargement around the cavity of the proboscis is filled with ova. The upper portion of the surface is covered with minute warts, the lower bears patches of bright crimson color. The whole has a greenish color throughout. The lower of the two divisions into which the sexual glands are divided is larger than the former, and has a slight constriction midway in its length. In it also, as in the former, the walls of the stomach may be easily seen, surrounded by the peripherally placed eggs. Like the lobe already mentioned, it too has patches of crimson color in its lower half, and the surface is set with lasso-cells (?). The mouth is simple, and destitute of tentacles or knob-like appendages. The tentacles are short, stiff, solid, or with a very small central cavity, and are generally carried at an angle to the bell. They are four in number. The tentacular bulb is large, spherical, with green pigment, and a single small black ocellus externally placed on a slight projection from the bulb. The distal end of the tentacle is a dumb-bell shaped organ, which is separated from it by a neck, the diameter of which is slightly smaller than the constriction in the dumb-bell shaped organ itself. The whole interior of the end of the tentacle is filled with patches of crimson pigment, which are enclosed in a layer formed of elongated cells placed side by side. Extending over this cell-layer is a second and thicker stratum, composed of smaller, less regularly arranged cells. All these histological structures taken together impart to this portion of the tentacle the resemblance to a specialized sense organ of some kind. The tentacle itself is composed of large central cells and a thin layer of ectoderm. Its interior resembles that of a *Cunina* tentacle.

Otocysts wanting.

Development unknown. Single specimen was a female.

Locality, Newport, R. I.

Zygodactyla groenlandica, Agassiz.

Plate V. Figs. 5, 6, 11, 12.

These jelly-fishes are sometimes two or three inches more in diameter than measurements which others have given. When fully extended, they are oftentimes eighteen inches in diameter. They are very abundant at Newport in the last of August. To the description which has been given of the adult can be added, that, extending in radial rows from centre to circumference, between each pair of radial tubes on the under side of the umbrella, there are rows of small tubercles or simple knobs, prolongations of the substance of the disk. There are about twenty such tubercles in each row. In the young *Zygodactyla* with eight tubes, these tubercles were present, but limited to a circle with a radius half that of the disk of the jelly-fish itself. I have not found similar tubercles placed on the inner surface of the umbrella described in any other medusa. In some cases, as often happens in a *Zygodactyla*, two of the tubes divide in their course half-way between stomach and bell margin. The lines of tubercles also bifurcate, and follow the tubes between which they lie. On each side of the base of a single tentacle of *Zygodactyla*, there is a green body, the function of which is not known. If the openings at the base of the tentacle are, as has been suggested, depuratory orifices, these structures may play some important part in this function. Plate V. fig. 11, taken from a young *Zygodactyla*, where the tentacle is but slightly developed, shows both the depuratory opening and the pair of green bodies adjacent to it. The very young tentacle has at its tip lasso-cells, which disappear with age. The relative size of the green bodies also becomes reduced as the *Zygodactyla* grows older.

The jelly-fish represented in Fig. 156 of the "North American Acalephæ" is probably not the young of this animal. It is too small, and has four genital organs, one on each of but four chymiferous tubes. The development of other tubes takes place before any sign of the genitals appears; and when sexual organs do develop, they do not begin as round bodies limited to one point on the tube, but as narrow folds along the whole length of the vessel. The stomach of a young *Zygodactyla* has a rectangular outline. Intermediate tubes really begin to form while there are but four tentacles, while the figure referred to (N. Amer. Acal., Fig. 156) has four chymiferous tubes and *twenty-four* tentacles.

The youngest *Zygodactyla* taken by me was captured with the drag-net in the last of June. It was a little more than an eighth of an inch in diameter, and is figured on Plate V. figs. 5, 6. The color of the bell on a black ground is pale green; that of the tentacles, cream-white. The radial tubes broad, four in number, each one arising from an angle of the rectangular stomach, and extending the whole distance to the bell margin. There are also rudiments of four other tubes, each of which arises from the side of the stomach midway between the pairs of primary tubes, and extends half the radius of the bell, and there ends abruptly in a slight enlargement. There are four tentacles corresponding with the tubes which are fully developed, and beginnings of four more, one midway between each pair of primary. The tentacles, as soon as developed to any extent, are coiled up when the animal is at rest, just as is the case in the tentacles of the adult. The outer surface of the bell is crossed by four meridionally placed rows of lasso-cells. These diminish in size with the growth of the *Zygodactyla*, and in the oldest medusæ are almost completely lost. No tubercles exist on the under side of the umbrella of a *Zygodactyla* as small as the example which I figure. Vertical outline of the stomach rectangular. Development unknown. Although the ovaries were crowded with eggs, I was unable to raise any of them, and cannot tell whether it has a hydroid or not, except on the grounds of comparative embryology of other and similar medusæ. Variations in the course of the tubes, their union, bifurcations, and number, are very numerous. In such cases of abnormal growths the ovaries which accompany the tubes follow the same variations.

Tima formosa A. Ag.

Plate VI. Figs. 1, 4, 5, 6.

A *Tima* was very abundant at Newport, in May of the past year, which later in the season disappeared altogether. In former years, I have begun my work there in June, and have never had a specimen of *Tima*. These facts lead to the conclusion that the medusa is a spring jelly-fish in Narragansett Bay.

Tima formosa, A. Ag. is closely related to *T. Bairdii* of Forbes. Of the former species, the only representative of the genus on our coast, Mr. Agassiz has given a good account. Larger specimens, with more tentacles than he mentions, were found, but in the main I have little to add to his description of the adult. He says that the otocysts have from four to five otoliths. This number is too small. In many otocysts of young jelly-fishes ten to fifteen otoliths were counted by me. The otocysts often form new ones by a process of self-division. Equatorially in a large otocyst a constriction takes place, which later deepens until the inner wall touches the floor opposite the point where the first sign of constriction appeared. The double otocyst, one of the component parts of which is usually smaller than the other, is now separated into two distinct otocysts by the growth of the intervening margin of the bell. Besides the production of otocysts by fission in this way, new otocysts also appear by a growth from the ectoderm of the bell rim.

The young of *T. formosa* is said by Mr. Agassiz to be without otocysts. A specimen of *Tima* still younger than that represented in Fig. 169 of the North American Acalephæ has two otocysts with otoliths, between each pair of the sixteen tentacles. The number of otoliths in each of these otocysts is seven.

Many specimens of this genus were without stomachs on the end of the proboscis. From many specimens taken in the last of May, a single example only was not mutilated in this way. A new stomach, however, grows quickly from the peduncle of a *Tima*. It forms by a process of budding in four or five days, so that all the oral tentacles are fully formed at the end of that time. The formation of the new stomach begins simultaneously in four points, which are near the terminations of the chymiferous tubes, at the end of the peduncle. As they increase in size they join at their sides, at last forming the stomach as it has been described in the adult.

Eutima gracilis, n. s.

Plate V. Figs. 1, 2, 3, 4.

A single specimen of a *Eutima*, which differs somewhat from either of the two species, *E. mira* and *E. variabilis*, described by McCrady, was taken in the tow-net. It differs from these, and also from *E. limpida* of Mr. Agassiz, in that each of the rudimentary tentacles, as well as those fully developed, bears a pair of lateral "spurs," or thread-like appendages. It may be the adult of any one of the three forms of *Eutima* which have been described from American waters, but the descriptions which have been given of them do not warrant a reference of it to any one of the known species.

The bell is shallow, rounded at the apex, and has very transparent walls. The surface is smooth. The radial tubes are thread-like, and from them hang small transparent sexual organs, which extend their whole length in the bell, but not on the proboscis. Their undeveloped condition indicates an immature individual. From the centre of the bell cavity hangs down a long, flexible, transparent peduncle, along which extend the four chymiferous tubes, after arching over from their radial course on the bell. The peduncle protrudes outside the bell opening, and carries on its end a globular stomach, which has a mouth with four oral tentacles. The latter structures have smooth lips, are undivided at the tips, and are destitute of knobs.

The tentacles arise from the margin of the bell at the junction of the radial tubes, and are four in number. They are long, flexible, hollow, and with apple-green colored tentacular bulbs. From the base of each tentacle arises a pair (one from each side) of thread-like "spurs," which are generally tightly coiled up, even when the tentacles themselves are extended. These tentacular appendages have a cream color. (For their relative position see Plate, V. fig. 1.) Intermediate between each pair of tentacles are four rudimentary structures, simple elevations of the bell margin, each of which has thread-like "spurs" similar to those found at the base of the four long tentacles. There are eight otocysts, two between each pair of long tentacles. Each otocyst contains numerous otoliths.

A single specimen of unknown sex was taken at Newport in the middle of August.

I have proposed the new name *E. gracilis,* although one of the forms already named may be its young.

Eucheilota ventricularis, McCrady.

Plate V. Figs. 7, 8, 9, 10.

This species of *Eucheilota* is not as abundant in Narragansett Bay as *E. duodecimalis.* The adult has been well described by McCrady, and two young stages are figured by Alexander Agassiz. My figures are of stages intermediate between those given by McCrady and the latter. McCrady's figure of the bell margin of the adult is in some particulars faulty. He figures (Plate XII. fig. 1, *b*) a tentacle on the bell rim, which has no lateral cirri. All the tentacles have in the adult these characteristic structures.

The first stage of *E. ventricularis* which I represent (Plate V. figs. 7, 8) is a little older than one figured by Mr. Agassiz, and has a flat bell with four simple, radial tubes, and eight tentacles, each with a pair of lateral cirri. There are eight otocysts, which alternate in position on the bell margin with the tentacles. The stomach is square in vertical outline, and hangs down about one third the whole depth of the bell cavity. No oral tentacles with knobs, or lasso-cells.

A second and following stage is also figured by me (Plate V. figs. 9, 10). This stage is a little younger than the adult as represented by McCrady. The whole number of tentacles has now increased to sixteen, and the new structures have appeared in such a position on the bell margin that between a primary tentacle and an otocyst there is now placed a single tentacle, so that each otocyst is separated from the adjacent by three tentacles on one side (the medially placed of which is a primary tentacle), and by one tentacle, the intermediate, on the other. This order in appearance of the tentacles is different from other hydroid medusæ.

The sexual organs are developed on the radial tubes, and are situated midway in their course between the stomach and the bell margin.

The figure which McCrady gives of the adult does not show the true form of the bell, nor the position and shape of the ovaries and proboscis. He omits also the lateral cirri found on intermediate tentacles.

Development unknown.

Locality, Newport, R. I.

This medusa was discovered in Narragansett Bay by Mr. Agassiz, who has kindly loaned me his drawings of it for study. Two specimens were taken by the author in 1880.

TRACHYNEMIDÆ.

Sphærula formosa, n. g. & s.

Plate I. Fig. 13.

A single small jelly-fish, closely allied to Gegenbaur's genus *Eurybiopsis*, was taken in August of last summer.

The bell is spherical, smooth, transparent, and with very thick walls. The depth of the bell cavity is about a half of the height of the bell itself. The radial tubes are simple, unbranched, and four in number. Their profile is not jagged. The veil is thick, muscular, and generally reversed, or turned into the bell cavity when the animal is at rest. In that respect it closely resembles *Trachynema digitale*, A. Ag. The motion of the animal in the water is accomplished in part by muscular action of the veil.

The proboscis is without peduncle, the stomach with open cruciform mouth There are no oral tentacles nor knobs. The mouth resembles closely the mouth of *Trachynema digitale*. Along the edges of the lips are rows of lasso-cells. The color of the whole proboscis is brownish and yellow.

There are four very flexible, hollow, smooth tentacles, with large tentacular bulbs carried at an angle to the bell. Around them the tentacles are often tightly coiled.

There are twelve otocysts, each composed of an *ectodermic* and *endodermic* layer. Ovaries wanting. Development unknown.

A single specimen of this jelly-fish was taken in the evening in August. I think from its want of ovaries that it is an immature form. The endodermic otolith leads one to place it with *Liriope* and *Cunina*, and not with Campanularians and Tubularians, where the whole otocyst with its enclosed otolith is ectodermic.

Trachynema digitale, A. Ag.

Plate II. Figs. 5, 6, 7.

Trachynema digitale is closely related to *T. ciliatum*, Gegenbaur. In the last part of May, this jelly-fish was very common in the bay, in every excursion filling the dip-nets with their numbers. I have been unsuccessful in a search for the very young forms, and have looked in vain in the stomachs of *Tima* and *Zygodactyla*, which were very common at the same time, in hopes of finding a case of commensalism, such as has been described in closely related medusæ.

A stage in the development of *T. digitale* younger than any yet mentioned is described below.

The bell of the youngest *Trachynema* is flat, without apical projection, and covered with small papillæ. The surface is destitute of cilia. The chymiferous tubes are broad, with smooth profile, and eight in number. Tentacles solid, stiff, with bright crimson pigment spots in their distal extremities, and with the surface ciliated. The crimson pigment spots at the end of the tentacles are in irregular patches of color, and perhaps correspond with similar structures in the tentacles of *Dipurena*. There are, however no such dumb-bell-like structures as are found in the latter genus. The number of tentacles is eight. The proboscis is short, destitute of a peduncle which is so completely developed in the adult. The mouth is cruciform, without oral tentacles, or knobs, and the lips are covered with lasso-cells. Color of the stomach, greenish, with brown shades. Otocysts four, each with a single centrally placed otolith which is endodermic.

In the past summer, all the intermediate stages between that described and the adult were found. My drawings add nothing to the figures and account which Mr. Agassiz has published. The tentacles of the adult are covered with cilia. The male of *T. digitale* was not found. The sexual organs were always extended with ova, which resembled the eggs of other medusæ in their transparency, and the possession of germinative dot and vesicle, both of which latter structures were plainly to be seen.

Cunina discoides, n. s.

Plate II. Fig. 8, and Plate IV. Figs. 1, 2.

The bell of *C. discoides* is flat, lens-shaped, transparent with smooth external surface. Radial tubes and extensions of the stomach wanting. No proboscis. The tentacles are solid, stiff, and borne at right angles to the vertical line of the bell. Number of tentacles fourteen. Below the bell is a gelatinous structure, collar-shaped, which hangs from the bell-margin as a circular ring, the width of which is about one half the height of the bell. This collar is crossed vertically by ribs (*peroniæ*), of which there are fourteen, each one arising from the base of the tentacle on the margin of the bell. These structures appear to give support to the tentacles, and have often been mistaken for vertical tubes. On the lower rim of the collar, which is called a sub-umbrella, are placed the otocysts. They contain each a single bright garnet-colored otolith, which is endodermic in its origin. Each otocyst is mounted on a short stalk. As the sub-umbrella hangs from the rim of the bell, so from the lower margin of the sub-umbrella is suspended a veil of about the same width as the sub-umbrella. It extends, however, at about right angles to the vertical axis, and forms a lower "floor" of the *Cunina*. The medusa is propelled in the water principally by the movements of this structure. The lower wall of the stomach is formed by a "washer-like structure" extended from the rim of the bell inwards at right angles to the vertical axis. The mouth is a simple circular opening in the centre of the washer last mentioned. The upper walls of the stomach are formed by the concavity in the lower surface of the umbrella. The stomach cavity appears full of granular particles, which are probably globules of chymiferous fluid. Sexual organs had not begun to develop. Development of egg unknown. The jelly-fish studied is probably an immature one, as the size and absence of sexual glands indicates. Whether it is identical with the Mediterranean species, which reaches a much larger size, is yet to be made out. It is not a frequent visitor in Narragansett Bay, and is undoubtedly brought there by the warmer waters of the Gulf Stream. Its anatomy shows that it is very different from Prof. McCrady's *Cunina octonaria.*

This description was made up from figures by Mr. Agassiz and a few rough sketches made by the author.

Liriope scutigera, McCrady.*

Plate VI. Figs. 7, 10, 11.

A single specimen of *L. scutigera,* McCr. was found at Newport in the summer of 1878.

Its bell is hemispherical, very transparent, with thick walls and smooth external surface. Radial tubes thread-like, unbranched, and four in number. Proboscis elongated, slender, with a long peduncle, which extends very far outside the bell opening. This peduncle is highly flexible. The lips of the mouth are simple, not elongated into oral tentacles, and cruciform when seen from below (Plate VI. fig. 10). Upon the lips are placed many lasso cells. The color of the lips is purple. A short gastrostyle hangs down as a continuation of the peduncle inside the stomach. No commensalists attached to it.

The tentacles are long, hollow, very flexible, and four in number. Lasso-cells are arranged in rings, alternating with smooth surfaces along each tentacle to its very tip.

Otocysts four, each one containing a single endodermic otolith. Each otocyst is sessile on the margin of the bell, and is accompanied by a club-shaped structure mounted on a short peduncle (Plate VI. fig. 11). The ovaries are situated on the radial tubes. They are heart-shaped, and so inflated with ova that their edges closely approach, where their width is the greatest.

The development of the egg is unknown.

* McCrady has published a partial description of this jelly-fish in his "Gymnophthalmata of Charleston Harbor," p. 106. A figure of the same is given in the North American Acalephæ, p. 60. The author of the latter does not represent the heart-shaped ovaries, but in his description says of them that they are more heart-shaped than McCrady describes. *L. scutigera,* McCrady, and *L. Catherinensis,* Fritz Müller, may be the same medusa.

SIPHONOPHORA.

Agalma elegans, Fewkes.

A. elegans is generally found once or twice each summer in Narragansett Bay. It appears with striking regularity about the end of the month of August.

In order to illustrate the general form of the adult there is given a life-size figure of one of the largest of these animals which was taken (Plate X.). Figures of the more important members of the colony and of younger stages can be found with explanations on Plate IX. The youngest *Agalma* figured in the latter plate (Fig. 2) resembles in some respects the genus *Athorybia*, and on that account is called the Athorybia stage. It is characterized by embryonic covering scales, which have serrated edges, and by peculiar tentacular knobs (Figs. 9, 9ª). Nectocalyces are not formed in this stage, and the float is surrounded by a crown of covering scales *fastened to an embryonic stem*, which is later absorbed. The covering scales of the adult *Agalma* (Figs. 3, 4) are not serrated along their margins, although their edges are crossed by rows of lasso cells (Figs. 11, 18), the tips of which, when seen in profile, impart the appearance of a serration to the border of the scale. The embryonic tentacles of the Athorybia larva never develop into those of the adult. These two structures, or at least the knobs which they bear, are so different in form in larva and adult that there is little doubt that they have different functions (compare Figs. 9, 9ª, with Figs. 20, 21).

The embryonic knobs do not resemble the tentacular knobs of the genus *Athorybia*, but are not unlike those of *Nanomia cara*, A. Ag. They bear on their distal ends long stiff hairs (cnidofils) which seem to arise from peculiar cells in the substance of the knob. They are non-retractile, and can be made to separate from or approach each other. All together generally when separated at their tips assume a fanlike shape. The mass of the knob itself is made up of large lasso-cells of two kinds. Of these the majority form a pavement of cells laid side by side, making a cup-shaped body, which is seen in the upper basal part of Fig. 9. The second kind of cells lie between these and those terminal cells out of which seem to issue the "cnidofils." The embryonic knobs have a darker crimson color than that possessed by the adult tentacular pendants.

The embryonic tentacle of the *Athorybia* larva arises from an embryonic polypite (Plate IX. fig. 14, *f*). This polypite is formed out of the modified yolk sac, and differs from the other polypites, which are formed later by the presence on the side towards the attachment of the tentacle, of a network of bright red pigment spots. The meshes of this latticework of pigment are clearly differentiated and well marked. This peculiar pigmentation distinguishes the embryonic polypite. All the others, which arise as simple buds from the stem, are destitute of the latticework of pigment found at the base or on the sides of the embryonic polypite. A larva of *Agalma* in a stage following the Athorybia stage bears a remote likeness to the genus *Physophora*. Although the resemblance is somewhat distant, for want of a better name I have called it the Physophora stage (Plate IX. fig. 1).

In this stage the tasters are arranged in a circle on an enlargement of the axis of the larva opposite the end which bears the float. This is a true characteristic of *Physophora*. Although nectocalyces are well formed, there is a section of stem between this terminal enlargement of the axis and the lowest nectocalyx which bears covering scales. This last feature separates the young *Agalma* from the genus *Physophora*. On the same enlargement which bears the circle of tasters there are two polypites, an embryonic, which is the modified yolk sac with the tentacle from which embryonic knobs are pendent, and a polypite with the characteristic tentacle and knobs of the adult. Both of these arise from the axial enlargement at the end of the stem. From a point on the axis just below the lowest nectocalyx hangs a single taster with tentacle, and small buds which later grow into polypites.

Tentacular knobs of both kinds coexist in this stage, but they are never found together in *Agalmata* in which there are more than four pairs of nectocalyces. No provisional or embryonic organs appear in stages between the Physophora stage and the adult *Agalma*. As far as the anatomy of the adult *Agalma* is concerned, I have little to add to what has already been given by others. In the arrangement of different individuals on the stem there is always a definite sequence, and the different individuals are never displaced from their proper order. Nectocalyces are always found on the nectostem, while feeding polyps, tasters, and sexual bells follow in an order which is exactly reproduced in different sections of the polyp stem. If we take a single such section the order is found to be as follows. Beginning with the upper end, there is found at first a polypite, just below which is the grapelike cluster of female bells. Removed by a considerable space on the stem from these, there is a cluster of tasters surrounded by male bells, and then, after another interval of about the same length of stem, another polypite with female bells and the beginning of a new section, which if followed out would be found an exact repetition of the preceding. This sequence is normally followed, whatever the length of the stem may be. New members of the polyp stem arise in the region just below the lowest nectocalyces. New nectocalyces always form on the nectostem just below the float.

In the *Agalma* which is figured in Plate X. there are seventeen pairs of nectocalyces, and seventeen sections bearing polypites and female sexual bells. This numerical identity is not a coincidence, but seems to occur normally in all stages of growth after that called the Physophora larva.

The development of the adult feeding polyp or polypite of *Agalma* seems to be quite peculiar. The feeding polyp originates as a simple two-layered bud from the stem, and assumes at first a globular shape. From this it elongates into a flask-like body, the proximal portion of which retains a spherical form, as shown in Plate IX. fig. 5. This spherical basal part is formed almost entirely out of a thickened middle layer, which lies between those which first formed the bud. On the distal portion of the walls of the spherical base of the polypites in this condition of growth many large lasso-cells arranged irregularly, as shown in the figure, make their appearance. At the base of the polypite where it joins the peduncle by which the feeding polyp hangs on the axis of the *Agalma*, there is a ferule-like structure, which has been called the "Wimperwulst." From this body in older stages the tentacular knobs, and after them the tentacles, later arise, Plate IX. fig. 7 *x*. As in its growth the polypite becomes older, Fig. 6, it takes on a more flask-shaped form, and the thickened median layer becomes reduced in size, while the lasso-cells in this region of the polypite increase in number. The Wimperwulst retains about the same size as in the former figure. In the next stage in the growth of the polypite, a part of which is figured in Fig. 8, the enlargement of the proximal end of this structure is still more diminished in size, and in the adult feeding polyp the reduction has gone so far that the swelling has completely disappeared, leaving between the Wimperwulst and the body of the polypite a kind of constriction richly covered with lasso-cells. This adult form is figured in Fig. 7. With the exception of the constriction between Wimperwulst and polypite the feeding polyps have already been well described by Leuckart, Gegenbaur, and others.

Closely connected with the growth of the polypite is the development of the tentacular knobs from the collar or Wimperwulst at its base. These bodies begin as simple buds, which elongate into hollow club-shaped structures of regular outline, Plate IX. fig. 22. In a somewhat later stage (Fig. 22^a) the distal end of the cavity of this organ slightly enlarges in diameter. Lasso-cells are present in the walls of the proximal part of the immature knob. These figures show that from the very first this "adult knob" is wholly different from that which has been called the "embryonic knob," Figs. 9, 9^a. The enlargement at the distal extremity increases in diameter (Fig. 22^c), differentiating three lobes from the extremity of the growing knob. The two lateral of these lobes by subsequent extension form those filament-like structures which I have represented in the adult knob, Figs. 20, 21, *b*. The medially placed lobe, which is the extremity of the knob placed in the angle between the two lateral prolongations, becomes the terminal sac (*a*, Figs. 20, 21) in the adult knob. The remainder of the half-formed knob coils itself together, passing into the future sacculus, while in its walls form those characteristic lasso-cells which distinguish this organ in the adult. Pigment also darkens its walls, and from its proximal part a circular rim is pushed out, which grows down around the sacculus enclosing it, in a sac which is shown in the figure of the adult knob as covering the whole sacculus, with the exception of the distal appendages, Fig. 21, *e*. In Fig. 20, *e*, this structure, which is called the involucrum, is drawn back to expose organs within, which otherwise could not be well shown. The last parts of the knob to be formed are two muscular threads, differentiated from the coiled sacculus, which connect the distal and proximal ends of the body of the knob, within the involucrum. These muscles have for a function the retraction within the involucrum of the extremity of the knob. They are shown in Fig. 20, *d*.

Eudoxia Lessonii, Huxley.

Plate VI. Figs. 8, 9.

In my paper on the Siphonophoræ (Bull. M. C. Z., Vol. VI. No. 7) a specimen of *E. Lessonii* is mentioned as taken near Newport. That mention is here supplemented by two figures of the medusa.

Diplophysa inermis, Gegenbaur.

Plate VI. Fig. 12.

In the figure given of this medusa, organs corresponding to those in *E. Lessonii* have the same lettering.

DISCOPHORA.

Cyanea arctica, Eschscholtz.

C. arctica is one of the more abundant jelly-fishes in Narragansett Bay. Three species of *Cyanea* called *C. arctica*, Per. & Les., *C. fulva*, Ag., and *C. versicolor*, Ag., have been described from the eastern coasts of the United States, by Prof. Agassiz. The main points of difference between *C. arctica* and the other species, *C. fulva* and *C. versicolor*, do not seem of sufficient importance to call for their separation. Differences in color in this as in many other *Discophoræ* may be the results of individual, seasonal, or sexual variations.

The Ephyra of C. arctica.

Very little is known of the ephyra of *C. arctica*. It has not been figured by Prof. Agassiz, and the representations by others are imperfect and few in number. It differs very greatly from the ephyra of our other common Discophore, *Aurelia*, and on that account I have introduced figures of it here. The genus *Cyaneopsis* of Brandt is an ephyra of *Cyanea*, as a comparison of the figures which I have given with his will, I think, make evident. The latest figures which have been published of the ephyræ of discophorous medusæ are those in an excellent paper by Claus,* of the genera *Aurelia*, *Chrysaora*, and *Pelagia*. In Agassiz's "Contributions" are excellent figures of the ephyra of *Aurelia*. No representations are found in either of these works of the ephyra of *Cyanea*. Agassiz gives a short description of the young of this genus, but of a stage considerably older than that which I discovered.

The youngest ephyra of *C. arctica* which was captured was caught with

* Studien über Polypen und Quallen der Adria.

the dip-net, in the month of May. I have given a figure, Plate VII. fig. 9, of an octant of this immature *Cyanea* seen from the oral side. This octant, as the other seven which compose the disk, bears an otocyst, and hence I shall in my description designate it as the sense octant. The lappets, one or the radius in which the otocyst lies, are called in my description pets, or lappets of the sense organs.

The movements of the umbrella of the ephyra are very rapid, and when at rest its lobes are thrown backward and upward, as in Plate VII. fig. 4ᵃ, expanding the oral folds and causing them to project in the manner shown in that figure. The diameter is between an eighth and a quarter of an inch. It has a light brown color, and at a superficial glance resembles an ephyra of *Aurelia*. The likeness of the ephyra of *Cyanea* to that of *Pelagia cyanella* as figured by Prof. Agassiz, or of *Chrysaora* as represented by Claus, is so close, that it might easily be mistaken for that of either of these genera.

There are eight sense lobes in the ephyra, as in the adult *Cyanea*. The incisions in the margin separating the lobes are very deep, and so wide that these bodies are removed from each other by an interval equal to the width of the lobe itself. The whole aboral surface of the disk is covered with very minute papillæ, which a little later in the growth of the ephyra elongate into prominent filaments, of which I shall speak later. To anticipate, let me say that the developed filaments are figured in Plate VII. fig. 1. The whole disk of the ephyra, especially the margin of the disk, has very thin walls.

The structure of the "lower floor" of the umbrella in the ephyra is very complicated. In the centre of the disk on this side there is found a mouth, which is a simple opening surrounded by a slightly raised, quadrate-shaped ridge, forming the lips. The elevation of this ridge above the lower floor of the ephyra is very slight, and the lips are as yet without folds. There are, however, four re-entering angles, one on each side of the rectangulár ridge, which impart to the mouth as seen from below a cross-shaped outline. Plate VII. figs. 9, 10. The points of this cruciform figure later elongate, and, hanging down like curtains, form the complicated folds of the oral appendages to the mouth.

From the under surface of the "lower floor" of the ephyra in the interval left by the re-entering angles in the ridge about the mouth there is formed a tentacle (S), differing in no respect from the first tentacles found on the umbrella margin. As there are four of these re-entering angles about the mouth, there are at first only four of these tentacles, one for each angle. Each one originates as a simple bud, and as they become more developed smaller buds form near and upon the base of that first developed. Plate VII. fig. 9ᵃ. The position in which this tentacle is found refers it to the sexual organs. In the adult *Cyanea* these tentacles are very numerous, and are found in rows above the sexual glands. In my figure, Plate VII. fig. 13, the natural position has been reversed, and the row of sexual filaments is found below the ovaries. In the genus *Cyanea* the sexual filaments of the adult are very minute ; in *Polybostricha dubia*, Br. they reach a much greater development.

Internal changes, in addition to those already mentioned, accompany the development of the ephyra into this stage of the young *Cyanea.* The stomach cavity is prolonged into extension between the umbrella and the lower floor of the medusa, as in the youngest ephyra, but these extensions have become broader, as the lobes in which they lie have become widened. The lateral branches, which in the ephyra were almost tubelike, are now much broader, yet still without bifurcations at their extremities. The circular muscular folds have become more clearly differentiated, and on the under side of the walls of the young medusa triangular-shaped muscles connected with these circular folds have begun to push out into the sense octants. In each sense octant there is a pair of these muscles, which at this stage are very minute, but are later greatly developed in the " under floor " of the adult. The otocyst of younger stages, as well as of the ephyra, is simpler than that of the adult. The "hood," which in the adult (*d*, Plate VII. fig.12ᵃ) covers and protects the sense organ, is not developed in any of the ephyra-like stages. The same is true of the oral curtains, Plate VII. fig. 12, *c*, which hang down on either side of the otocyst in the adult.

One half of an octant of a young *Cyanea* still older than that represented in Plate VII. fig. 8 is shown in Fig. 7. The more important internal changes which have taken place are the results of the enlargement and filling out of the margin of the umbrella to a more regular and unbroken outline, and the addition of new tentacles in the marginal clusters. There is also a multiplication of sexual filaments, many of which have been removed from the figure to avoid complication. The function of these sexual filaments in the adult is somewhat doubtful. They are said to have a motion by which the water in proximity to the sexual organs is removed, and pure water continually made to replace the impure. This motion I have never observed, nor am I able to distinguish the male *Cyanea* from the female. The figures which are given in Agassiz's " Contributions " of the immature ovaries and spermaries, resemble each other very closely, the spermaries possessing folds in the mesentery-like membrane (*o. s.*). Are not like folds also sometimes found in the ovarian organs? I figure, Plate VII. fig. 13, the ovaries of a *Cyanea*, of which the ova were not mature. Plate VIII. fig. 13, illustrates the microscopical structure of the egg and its envelope in the ovary of the same age.

Outside the four tentacles formed in the re-entering angles of the lips of the ephyra of *Cyanea*, there is a ring in the lower floor which is less transparent than the remainder of the floor, and thickly striated. This ring is the origin of the muscular folds in the lower floor of the adult *Cyanea.* The lower floor is joined to the umbrella itself by perpendicular partitions, eight in number, each situated on the lines where the sense octants join each other.

In the angle of the incisions in the margin of the umbrella separating the lobes which bear the otocysts, there arises from the oral side of the ephyra, at the same time with the sexual tentacle, another of about the same size. As there are eight of these incisions, there are at first eight of these tentacles. They originate as simple buds, and elongate to a length equal to the diameter of the ephyra. One of these is always in advance of the others in time of appearance, and is the longest. This predominance of one of these marginal appendages is another expression of bilateral symmetry, which, as has been pointed out by others, is well marked in the tentacles in the younger scyphistoma stage of *Cyanea* and *Aurelia*.

In the ephyra in which there are eight tentacles on the margin of the umbrella, octants of which I have represented, Plate VII. figs. 9, 10, the resemblance to the members of the family of *Pelagidæ* is very striking. Not only in the outward form is this likeness apparent, but in the internal anatomy the resemblances are very close. One of the most striking of these anatomical likenesses is to be seen in the course of the chymiferous tubes in the sense octants of these two forms. If one will compare Fig. 9 with a sense sector of *Pelagia cyanella*, he will find the tubes almost identical in their course. The addition of new tentacles on the margin of the umbrella of the ephyra takes place by the growth of new tentacles on either side of that first formed, and in pairs, one on each side at the same time. These grow along two sides of a V-shaped figure, in which the first formed tentacle is situated at the angle of the V, and is directed towards the centre of the ephyra. The subsequently formed tentacles to the primary always arise external to those already developed. Marginal tentacles in all stages of growth, from a bud to a well-developed filament, arranged along the figure of which I have spoken, are shown in Plate VII. fig. 8. The same figure shows also the changes which have taken place in the contour of the rim of the sense octant, and the greater development of the bundle of sexual tentacles. The specimen from which the drawing was made was not raised from the larval ephyra, but was taken free swimming in the dip-net.

In some of the older forms following the ephyra stage, the upper surface of the umbrella is covered with peculiar undescribed filaments. These are well shown in a young *Cyanea* somewhat older than that, an octant of which is figured, Plate VII. fig. 7. This stage with the filamentous appendages is shown, Plate VII. fig. 1. The whole upper surface of the umbrella is covered with peculiar tentacles of unknown function. They are most developed in younger stages, but are not wholly wanting in the adult. The filaments to which I refer were first noticed in these young *Cyaneæ* by Dr. Walter Faxon. Of the anatomy of these filaments there is very little to be said. They are very flexible, transparent, of brownish color, tapering uniformly from base to extremity, and seem to be simple prolongations of the substance of the bell, covered by a layer resembling that which is stretched over the whole of the aboral surface of the umbrella. They are also solid, and destitute of lasso-cells. Their superficial layer is penetrated by those same nerve cells which are found all over the surface of the umbrella, the histology of which has been so elaborately investigated by Dr. Eimer. These cells are undoubtedly connected with sensation of some special kind, and we may consider with great probability that the aboral filaments are specialized sense organs. I suggest for them, whatever their function may be, the name of "aboral papillæ." In some genera of *Discophoræ* the same appendages also exist, but they are nowhere as prominent as in the young of *Cyanea*. In *Aurelia*, Plate VII. fig. 6, they are represented by wart-like excrescences of small size, covering the whole upper surface of the bell, even to the marginal lobules.

On the Sense Organs found on the Bell Margin of Cyanea arctica.

The structure of the sense organs found in the rim of the bell of *Pelagia*, *Aurelia*, and *Cyanea* has been carefully studied by Dr. Eimer. His observations of *Cyanea* are less complete than of the other genera, and as the differences are in some respects so radical, I have here described the more important details of their anatomy again. The "marginal sense bodies" of *C. arctica* are eight in number, and are situated at equal distances on the rim of the umbrella in incised angles, slightly removed from the margin. Morphologically, each of these structures is a modified tentacle, as pointed out by Agassiz.

The eight extensions of the stomach in the interval between the lower surface of the umbrella and the lower floor are separated from each other by vertical partitions connecting these structures. The early condition of these vertical partitions has been already mentioned in speaking of the ephyra. It remains to be noticed that they lie in radial lines, separating the octants which bear the sense bulb from those from which the bundles of marginal tentacles hang. The chymiferous tubes or extensions from the stomach into the periphery of the disk divide as they approach the margin of the umbrella into a single small central, and two large lateral branches. The central of these, which is medially placed, extends directly into the otocyst, while the lateral divisions are subdivided into many dendritic branches, becoming more and more subdivided as they approach the margin of the lobes on either side of the sense bulb or otocyst. It will be seen, however, by a consultation of the figures, Plate VII. figs. 7, 12, that only a part of the lobes adjacent to the sense bulb is penetrated by branches from the optical extension of the stomach, part of which passes into the otocyst. By far the greater number of dendritic branches arise from chymiferous tubes, which lie in the same sector as the bunch of marginal tentacles. The dendritic branches of the main divisions of the ocular tube are of two kinds, one of which spreads itself out in the margin of the umbrella, while the other, arising from the sides of these tubes, extends into curtain-like folds (Plate VII. fig. 12 *c*) on the under surface of the umbrella. These curtains are placed as follows. On the aboral side of the adult *Cyanea* the otocyst is covered and protected by a roof-like prolongation of the upper surface of the umbrella into what is known as the hood (Plate VII. fig. 12[a], *d*). On the oral side, this hood does not exist in the same form. It is, however, represented in the oral curtains. When one carefully examines the otocysts from below, or from the oral side, they are found to be protected by raised walls or curtains, which do not join each other, but arise from the edges of the adjacent lobes and extend parallel with each other from the base of the otocyst to a distance far beyond its distal end. They are so placed in reference to each other that their free edges, which are crescent-shaped, slightly overlap (Plate VII. fig. 12, *c*). It is as if we had a hood on the oral side of the sense organ only split along the medial line.

Into these curtains extend the dendritic branches from the sides of the main branches of the extensions from the stomach into the sense octants of the umbrella. What the "hood" accomplishes on the aboral side, these lappets partially perform on the oral aspect of the disk. Both structures serve for the protection of the delicate parts which they surround.

Upon the base of the style which bears the otocyst in the genus *Cyanea*, and on its oral surface, there rises an elevation, Plate VII. fig. 14, covered with papillæ, which I think are connected with the function of sensation. This structure takes the place of an organ found on the aboral surface of the disk of *Aurelia*, and called by Eimer the "Sinnespolster." The "Sinnespolster" of *Aurelia*, as he says, is wanting in the aboral surface of *Cyanea*. It is represented in part by this wart-like protuberance covered with papillæ (Plate VII. figs. 5, 14), on the under surface of the otocyst style. Whatever the function of this organ may be, it has escaped the notice of all those who have studied the nervous and sensatory systems of this genus. In *Aurelia* this protuberance on the style in *Cyanea* is wholly wanting, and is perhaps represented by that structure wanting in *Cyanea*, and called the "Sinnespolster."

There remains yet to be noticed in my description of the general form of the sense organ of *Cyanea* certain hollows or angles in the neighborhood of the otocysts formed in the rim of the umbrella. I refer to organs which Eimer has called the inner "Reichgrübschen." As the style of the otocyst rises from the margin of the umbrella, it leaves on either side, between it and the lateral folds, two small recesses. One of these cavities is shown on Plate VII. fig. 12, just above the point where the curtains, *c*, begin to rise from the oral surface of the sense lappets, and on a level marked by a line drawn through the papillæ perpendicular to the radius of the medusa. On the aboral side the "hood," and on the lower, which is for the most part open, a part of the ends of oral curtains (*c*), Fig. 12, enclose the recesses thus left, so that they resemble imperfectly closed furrows in the edge of the disk walls. These cavities are said to be sensitive, their walls are so thickly set with nerve cells. The cavity of the adult otocyst is filled with hexagonal calcareous otoliths of prismatic shape, terminated by six-sided pyramids. The centre of each prism is filled with a small cube which resists the action of caustic potash. In addition to an elongated prismatic form with terminal pyramids, many of these otoliths are hexagonal lozenge-shaped, with flat terminal facets. The color of the otoliths is bright orange, and when enclosed in the otocyst renders it very prominent in the midst of the transparent walls of the umbrella. A cluster of small otoliths is found on the under side of the otocyst near its junction with the style, which may be the same as the ocellus described by Claus in *Aurelia*, while the larger otoliths belong more to a different organ of sensation. If that is true, in the otocyst of the *Cyanea* is an organ of sense representing the ocellus and the true otocyst of certain hydroid medusæ.

The walls of the otocyst are made up of three layers, of which the external alone stretches over the terminal end of this organ. In this layer are epithelian cells, modified into nervous elements. The otocyst is fastened to the style, which bears it on the lower side, so that, instead of being continued directly into it, the cavity opens from the upper sides of the otocyst through the under side of the style.

Exceptions to the regular number of otocysts in *Cyanea* and *Aurelia* are common.

Aurelia flavidula Per. & Les.

A few specimens of this medusa were taken each summer. They were as a general thing fewer in number and smaller than those found in Massachusetts Bay. An *Aurelia* as large as a water-bucket, which is not a rare sight north of Cape Cod, I have not seen in the southern bays. A side view of a small *Aurelia* is beautifully figured in the well-known "Contributions to the Natural History of the United States." The figure is taken from a medusa with contracted bell, and oral lobes, and consequently there is no representation in it of the otocysts. I have given a figure of *Aurelia* with disk expanded and oral appendages extended, in order to show, more plainly than one in which these parts are drawn together can, the position of the sense organs to which I wish to call special attention. (Plate VII. fig. 2.)

The otocysts of *Aurelia* differ very greatly from those of *Cyanea*, yet still we can in both recognize homologous parts. The oral curtains hanging down one on each side of the otocyst of *Cyanea* are wanting as such in *Aurelia*. They are represented in part by two lappets, one on each side of the sense bulb, *a*, Plate VII. fig. 3. Corresponding morphologically with the dendritic divisions found in the oral curtains and adjoining sense lobes of *Cyanea*, there are in *Aurelia*, arising as branches from the prolongation of the stomach into the sense octant, two blindly ending horn-shaped tubes, which, as seen from above (Plate VII. fig. 3, *b*), appear to embrace the style of the otocyst, and extend a short distance into the base of the lappets, *a*, Plate VII. fig. 3. The prolongation of the stomach into the sense octant, in *Aurelia*, takes the form of a straight tube, the diameter of which is quite small. This tube, after arising from the stomach, passes directly towards the margin of the disk, and when near the otocyst opens into a circular-shaped enlargement. Into the same cavity pass also two other pairs of chymiferous tubes, one on each side, which are branches from another system of vessels likewise extensions of the stomach. From the under floor of this cavity, which is shown in Plate VII. fig. 3[a], near its peripheral part, there arise three small ~~vessels~~ besides those which have been already mentioned. One of these, the median, is continued directly into the cavity of the otocyst, passing through the style of the same, while the others, the two lateral branches, are the horn-shaped tubes which seem to embrace the style of the otocyst, and enter for a short distance the lappets of the sense bulb. Their extremities never become dendritic, but end blindly in the substance of the lappet. As has been hinted at above, these sense lappets in *Aurelia* are represented in part by the oral curtains hanging down, one on each side of the otocyst of *Cyanea*, Plate VII. fig. 12, *c*. The lateral tubes which enter their bases are strictly homologous to the early conditions of the lateral branches in the ephyra of *Cyanea*, Figs. 9, 10. That there is this resemblance between the marginal sense bodies of the young *Cyanea* and the adult *Aurelia* is still another fact added to many others, that *Cyanea* stands higher in the scale of life than *Aurelia*, or that *Aurelia* is an arrested stage of development similar to the young of *Cyanea*.

Dactylometra quinquecirra, A. Ag.

Plate VIII. Fig. 14.

D. quinquecirra is a rare medusa in Narragansett Bay. One or two specimens are taken each summer. The adult, one half natural size, is shown in Plate VIII. fig. 14. The genus is characterized by the presence of five tentacles between each pair of otocysts. In other respects it resembles *Pelagia*, to which genus it was referred by Desor.

The umbrella is thickly pigmented with brown and red spots, which are very large in the middle of the upper surface of the umbrella. The color of the bell is pale blue and brown. The same color with pigmentation is likewise found on the tentacles.

There are oral appendages of two kinds, four of which are quite long, floating gracefully along after the medusa as it swims in the water. The remaining oral appendages are shorter, more ruffled, confined to the immediate vicinity of the mouth, and extending only a short distance outside of the bell below the lower floor. The stomach lobes are united at their bases, yet not by a solid circular ring such as exists in *Cyanea*. Ovaries yellow, hanging in baglike masses between the pillars by which the oral appendages are suspended. In alcoholic specimens there are no circular muscular folds such as exist on the lower floor of *Cyanea*. The whole umbrella is very flexible. Size six to ten inches in diameter. There are generally five tentacles between each pair of marginal sense bulbs. These tentacles vary in size, and oftentimes there are but three or four between each pair of otocysts. The chymiferous tubes resemble closely those of the genus *Pelagia*. They are not dendritic at their distal ends, as is the case with *Cyanea*, nor branched as in *Aurelia*, but pass directly to the vicinity of the otocysts, where they divide, sending a branch into the cavity of this structure, and lateral forks which are continued into a tube which runs along the margin of the disk.

CTENOPHORA.

Mnemiopsis Leidyi, A. Ag.

M. Leidyi is one of the most common Ctenophores in Narragansett Bay. In the latter part of the summer and early autumn these jelly-fishes fill the water in Laboratory Cove, Newport, and can be found in almost all stages of development. *M. Leidyi* resembles very closely *Bolina alata*, Ag. What is very much needed is a critical examination and comparison of both genera. Mr. Agassiz says the latter genus is limited to north of Cape Cod.

Mnemiopsis is distinguished from the other Ctenophores, except *Bolina*, by the great development of the lappets or lobes on each side of the mouth, and their irregular triangular profile (Plate VIII. figs. 1, 2). The rudimentary tentacles lie in a groove, covered by a "hood" resembling a structure of the same name in *Cyanea* covering the otocysts.

The young *M. Leidyi* recalls a *Pleurobrachia* in possessing long, flexible tentacles with secondary appendages (Plate VIII. figs. 3, 4). These tentacles become more and more reduced in size with the growth of the young *Mnemiopsis*, until in the adult they reach the rudimentary condition figured in Plate VIII. fig. 9. The presence of well-developed tentacles in the young *Bolina* was first pointed out by Prof. McCrady.

Another likeness between the young *Mnemiopsis* and the tentaculated Ctenophores, like *Pleurobrachia* is the development on its aboral pole of a special "sense area" of peculiar shape (Plate VIII. figs. 5, 5^a). The outline of this area as that of the same in the adult *Pleurobrachia*, is dumb-bell shaped, and the otoliths are enclosed in an otocyst, midway between the two extremities. On either side of the centrally placed cluster of otoliths, yet within the same sac or otocyst, is a single otolith not yet united to the cluster. As the *Mnemiopsis* grows older, the dumb-bell like area of the larva is reduced in size by drawing in the two extremities, until, in the adult, it has almost wholly disappeared. It seems to be an embryonic sense organ, which is confined to larval stages of higher Ctenophores, and to the adult of such lower forms as *Pleurobrachia*. The adult of *M. Leidyi* (Plate VIII. figs. 1, 2) is very transparent, when contracted (Fig. 2) ovoid, and when expanded roughly triangular in profile. In each lateral hemisphere the walls of the body are continued into lappets of great size hanging down on either side of the animal. These lappets are very movable, and when the jelly-fish is alarmed they close together below the mouth. Their inner walls are crossed by a network of muscular lines (Plate VIII. fig. 11) composed of small cells placed side by side. The external surface of the body is thickly dotted with small papillæ. The oral lappets are separated from each other by deep longitudinal furrows along the sides of the body. The diameter of the jelly-fish from the floor of one furrow to that of the opposite is much less than that from one surface of the oral lappets to the other. In the former of these planes lies the longitudinal axis of the mouth and the rudimentary tentacles. The length of the Ctenophore from mouth to sense bulb is about one half the whole length of body and oral lappets taken together.

In the longitudinal furrows and on each side of the medial line of the same lies a single auricular appendage (Plate VIII. fig. 2, *h*), which arises from the walls of the body just above the line, passing through the mouth at right angles to the axis of the jelly-fish. These structures extend a short distance below the level of the mouth. Their general form is seen in Fig. 2. They are lined with a vibratile plate. There is a pair of auricular appendages in each furrow, making four on both sides.

The rudimentary tentacles are placed in a medial position in the furrow at the extremities of a diameter passing through the longitudinal axis of the mouth. They are club-shaped (Plate VIII. figs. 7, 8, 9), and bear in their reduced condition small filaments or secondary appendages. These filaments are also found on the adjacent ridges of the body, extending in two rows, one on each side of the tentacle to the angle where the tubes from the "oral lappets" and "auricular appendages" join (Fig. 10). The recess in which the rudimentary tentacles lie is closed on one side by a "hood," *d*, Plate VIII. fig. 8. The tentacle springs from the body walls, and is affixed by one end and by a part of the lateral walls. In the adult the tentacle rarely projects beyond its socket. Its secondary appendages, however, are often extruded beyond the rim of the hood which shields the club-shaped tentacle to which they are affixed. The socket in which the tentacle lies, and one wall of which is made by the "hood," is the diminutive representative of the tentacular socket of *Pleurobrachia*. Scattered pigment cells of crimson color in the base of the tentacle may represent a former ocellus. On either side of the base of the tentacle, Plate VIII. fig. 7, 8, *a*, the socket is continued into recesses not unlike the sense organs called "Riechgrübschen" in the bell margin of *Cyanea*.

The course of the lines of comblike swimming plates differs but little from that of the same structures found on the surface of the body in other *Ctenophoræ*. There are eight rows of combs, four of which are much longer than the remainder. The modifications in their length are due to the abnormal development of the oral lappets. The rows of vibratile combs, which are situated on the same hemispheres from which the lappets are suspended, are much longer than those which lie in the furrows between these lobes. Isolated single combs from front and side are shown in Plate VIII. figs. 12, 12^a. These combs retain their power of motion even when separated from the jelly-fish, and are often found rolled into a spherical ball, which is kept in rotation for a considerable length of time by their combined motion.

With the exception of eight small vessels passing along the upper surface of the bell to the locomotive flappers, there are in *Mnemiopsis* no tubes which take origin from the upper end of the "funnel" near the otocyst. All the tubes arise from the lower extremity of the "funnel" just at its union with the upper end of the stomach, and not from the other extremity, upon which the otocyst is situated. The "funnel" itself is very short, but is well marked. From the lower end of the funnel arise six tubes, four of which by subsequent subdivision form the tubes, which lie under the locomotive flappers, while the remaining pair extend to the region of the mouth, each of the latter passing into a tentacle, *b*, Figs. 7, 8. The appearance of these tubes in the young *Mnemiopsis*, when they closely resemble each other, is shown in Fig. 8.

The edge of the "auricular appendages" has fastened to it a vibratile plate, which extends, without break, from the base on the side turned to the medial line, to the angle which the rim of the oral lappets makes with the body of the animal. This vibratile plate is homologous with the vibratile combs, of which it is the exact continuance. The bright crimson pigment spots found in a row at its base and along the auricles are probably functional, but, whether sensory or not, has not been determined.

From the origin of the tentacle to the angle formed by the oral lappets and a ridge from the auricular appendages, Plate VIII. fig. 10, there passes a row of small tentacula-like bodies, which closely resemble the filaments or secondary appendages to the rudimentary tentacle. They resemble closely the tentacles foung along the bell margin in *Aurelia* (Plate VII. fig. 6). Folds in the walls of the intestine near the upper end of its course are well marked. These structures are figured in *Bolina* by Mr. Agassiz.

The upper part of the funnel and the otocyst of *M. Leidyi* is figured in Plate VIII. fig. 6. The bundles of nerves which pass from the ganglion beneath the otocyst distribute nerves to all the important organs of the body. Their course can be traced very well, even to the margin of the oral lappets. They are unbranched, and of a white, almost silvery color. Their course in a small portion of the inner surface of the oral lappets has the appearance shown in Plate VIII. fig. 11. There is in the adult no circumscribed aborally placed sense organ of dumb-bell shape similar to what has been mentioned in the young, Plate VIII. fig. 5^a. A part of the body walls around the otocyst has a granulated appearance, which may represent this structure in a reduced form.

The otocyst is a two-layered sac containing otoliths arranged in a cluster. This sac is without apical opening. The connection of the otoliths with the ganglion is through the walls of the floor upon which the cluster rests, and not by suspension from the upper walls of the capsule. Four bundles of nerves arise in a symmetrical manner from the ganglion, two of which are well marked, and extend into the oral lappets, *d*, Fig. 6.

The network of lines on the inner walls and surface of the oral lappets is arranged with great regularity, and does not form those characteristic spots, four in number, which exist in *Ocyroë maculata*, Rang. Each line in the network is made up of small cells, laid side by side. Nerve fibres are especially rich in the oral lappets, which, as a result, are highly sensitive, quickly responding by retraction when the surface is touched.

CAMBRIDGE, February, 1881.

EXPLANATION OF THE PLATES.

The size of the medusa is indicated by a line at one side of the bell. A line of this kind refers to the bell exclusive of appendages.

PLATE I.

Fig. 1. *Lizzia grata.* This specimen is not fully developed, but has attached young, one of which is almost ready to separate from the attachment, and can be seen through the bell walls.

Fig. 2. Young bud of the proboscis of *L. grata.* The capsule in which it is confined, when attached, has been removed, and the tentacles drawn apart.

Fig. 3. The bell margin of *L. grata* as it breaks away from attachment to the parent's proboscis.

Fig. 4. Bud on the proboscis of *L. grata* inside the capsule.

Fig. 5. Tentacles around the mouth of adult *L. grata,* which has one bud from the proboscis.

Fig. 6. Young *L. grata* just before the rupture of the connection with the parent.

Fig. 7. Very young *L. grata* with infolded tentacles.

Fig. 8. *Gemmaria gemmosa* (adult). Only one tentacle is represented.

Fig. 9. *G. gemmosa* (natural size).

Fig. 10. Tentacular bulb of *G. gemmosa.*

Fig. 11. Tentacular knobs of *G. gemmosa.*

Fig. 12. Aboral view of *G. gemmosa.*

Fig. 13. *Sphærula formosa* (young ?).

PLATE II.

Fig. 1. *Stomatoca apicata* (adult). Only a single tentacle is represented.

Fig. 2. Young of *Dinematella cavosa.*

Fig. 3. Apex of the bell of *D. cavosa.*

Fig. 4. Base of the proboscis of *S. apicata* (male ?).

Fig. 5. Young of *Trachynema digitale.*

Fig. 6. View of the same from oral side. One tentacle represented.

Fig. 7. Part of the bell rim of *T. digitale* (adult) showing parts of two chymiferous tubes and of the tentacles.

Fig. 8. Tentacular bulb of *Cunina discoides.*

Fig. 9. Four stages in the development of the egg of *S. apicata.* The lowest figure is the ciliated planula. Size of planula $\frac{1}{32}$ inch.

PLATE III.

Fig. 1. *Turris episcopalis* (adult). One tentacle figured.

Fig. 2. Young of *T. episcopalis.*

Fig. 3. Upper part of the bell of *T. episcopalis*. This figure shows one of the four continuations of the bell cavity into the apical prolongation of the walls of the bell.

Fig. 4. Optical section of the ovaries and bell margin of *T. episcopalis*. The origin of two long tentacles and the three intermediate papillæ is shown on the lower side.

Fig. 5. The tentacular bulb of *T. episcopalis*. The figure shows the relative position of the ocellus.

Fig. 6. Undeveloped tentacular papilla of *T. episcopalis*.

Fig. 7. Tentacular bulb and ocellus of *Modeeria multitentacula* (lower side).

Fig. 8. *Modeeria multitentacula*.

Fig. 9. Optical section (from aboral side) of the same.

Fig. 10. Tentacular bulb of *M. multitentacula* (right side).

Fig. 11. Ocellus and base of a tentacle of *Sarsia mirabilis*.

Fig. 12. Cells and pigment spots of the spherical base of the tentacle of *S. mirabilis*.

PLATE IV.

Fig. 1. *Cunina discoides*.

a. Sub-umbrella.

b. Otocyst.

v. Veil.

Fig. 2. View of *C. discoides* from oral side. One tentacle and one otocyst represented.

Fig. 3. *Dinematella carosum* (adult).

c. Cavity in the apical prolongation of the bell.

Fig. 4. Young *Turritopsis nutricola* (oral view).

Fig. 5. *Dipurena strangulata* (adult).

Fig. 6. Pedunculated structure found on the adult oral lappets of *T. nutricola*.

Fig. 7. Young *T. nutricola* (side view of Fig. 4).

Fig. 8. Oral appendages of *T. nutricola*.

Fig. 9. Stage in development of *T. nutricola* between Figs. 7 and 10.

Fig. 10. *Turritopsis nutricola* (adult).

PLATE V.

Fig. 1. *Eutima gracilis* (adult).

Fig. 2. Two rudimentary tentacles (?) with cirri, and a single ocellus, of *E. gracilis*.

Fig. 3. Tentacular knob of *E. gracilis* (adult).

Fig. 4. Mouth of *E. gracilis* (adult).

Fig. 5. Young of *Zygodactyla groenlandica*.

Fig. 6. Side view of the same.

Fig. 7. *Eucheilota ventricularis* (young).

Fig. 8. *E. ventricularis* (oral view).

Fig. 9. Half of *E. ventricularis* (adult).

Fig. 10. Quadrant of *E. ventricularis* (oral view).

Fig. 11. Single undeveloped tentacle of *Zygodactyla groenlandica*.

c, c. Green bodies.

Fig. 12. Sextant of adult *Z. groenlandica* (oral view.)
- *c.* One of four meridional lines of lasso-cells (?) on the bell.
- *d.* Tubercles arranged in rows between the radial tubes, and situated on the under side of the bell.
- *v.* Velum.

PLATE VI.

Fig. 1. *Tima formosa* (young).

Fig. 2. *Mabella gracilis.*

Fig. 3. *M. gracilis* (side view).

Fig. 4. Otocyst of *T. formosa* (from young figured in Fig. 1).

Figs. 5, 6. These two figures show how by fission two otocysts of *T. formosa* are formed from one.
- *h.* Point of constriction of walls.

Fig. 7. *Liriope scutigera* (adult female).

Fig. 8. *Eudoxia Lessonii* (side view).
- *a.* Primitive covering scale.
- *b.* Oil globule. This oil bubble is *not* the same as the float of *Agalma.*
- *c.* Somatocyst.
- *d.* Tentacle.
- *e.* Nectocalyx.
- *f.* Tentacular knob.
- *g.* Chymiferous tubes of the nectocalyx.
- *i.* Oil globule in somatocyst.
- *p.* Polypite.
- *s.* Female sexual bells.

The lettering in Figs. 8, 9, and 12 corresponds.

Fig. 9. *Eudoxia Lessonii* (dorsal view).

Fig. 10. Mouth of *Liriope scutigera.*

Fig. 11. Otocyst of *L. scutigera.*

Fig. 12. *Diplophysa inermis.*

PLATE VII.

Fig. 1. Young of *Cyanea arctica*, showing the filaments covering the upper surface of the bell.

Fig. 2. *Aurelia flavidula.*

Fig. 3. Marginal sense organ of *A. flavidula.* View from the dorsal surface.
- *a.* Sense lappets.
- *b.* Sinnespolster.

Fig. 3[a]. Same as above from oral surface.

Fig. 4. Ephyra of *C. arctica.* Margin of the disk contracted.

Fig. 4[a]. The same with disk margin expanded.

Fig. 5. Marginal sense body of *C. arctica* (young).

Fig. 6. Margin of the bell of *Aurelia flavidula* with lobules and tentacles.

Fig. 7. Portion of the disk of a young *Cyanea* in which the sense organ and bundle of tentacles are shown (oral view).

Fig. 8. An octant of the disk of *Cyanea* showing the early condition of the chymiferous tubes, the sexual filaments, and the bundles of marginal tentacles.

Fig. 9. Octant of the ephyra of *C. arctica* (oral view).

s. Single sexual filament.

Fig. 10. Still more developed ephyra of the same (oral view).

Fig. 11. Aboral view of the region of the bell margin in which the sense organ is situated (*Cyanea*).

Fig. 12. Marginal sense organ of *Cyanea*.

c. Single curtain hanging down on the left-hand side of the otocyst.

Fig. 12a. Hood covering the otocyst on aboral side.

Fig. 13. Sexual organs and sexual filaments of *Cyanea* (female).

Fig. 14. Peculiar sense organ (?) on the under side of the peduncle of the marginal sense organ of *Cyanea*.

PLATE VIII.

Fig. 1. *Mnemiopsis Leidyi*, expanded, life size.

Fig. 2. The same, contracted and seen in a plane at right angles to Fig. 1.

a. Sense pockets of the tentacle.

h. Vfbratile plate.

i. Intestine, with surrounding glands.

j. Rudimentary tentacle.

l. Vibratile combs.

Fig. 3. Young of Fig. 1 (*Mnemiopsis Leidyi*) with embryonic tentacles extended.

Fig. 4. Side view of the same.

Fig. 5. Aboral view of the young of *M. Leidyi* a little younger than those figured in Figs. 3, 4.

Fig. 5a. Sense area of young *Mnemiopsis*.

Fig. 6. Sense organ, with nerves (*d*) of adult *Mnemiopsis*.

Fig. 7. Rudimentary tentacle of a young *Mnemiopsis*.

Fig. 8. Rudimentary tentacle of the adult of the same.

a. Sense pockets.

b. Chymiferous tube.

d. H od covering the rudimentary tentacles.

Fig. 9. Side view of the tentacle raised from the socket in which it lies.

Fig. 10. Place of junction of tubes in the angle made by the oral lappets and the body of the Ctenophore (*Mnemiopsis*).

e. Tube from the ambulacral combs.

f. Row of pigment spots extending to the tentacle, and bearing small thread-like tentacles.

Fig. 11. Cells found forming a network on the inner surface of the oral lappets of *Mnemiopsis*.

Fig. 14. *Dactylometra quinquecirra*, A. Ag.

PLATE IX.

Fig. 1. Young of *Agalma elegans*.

Fig. 2. Athorybia stage of *A. elegans*.

Fig. 3. Covering scale of *A. elegans* (adult).
 c'. Central tube.

Fig. 4. Side view of the same.

Figs. 5, 6, 7, 8. Development of the feeding polyp of *A. elegans*.
 x. Structure at the base of the polypite from which arise the tentacles. The region between this and the body of the polypite is homologous to the spherical enlargement with lasso cells shown in Fig. 8.

Fig. 9. Provisional tentacular knob found on the first tentacle formed in the early stages (*Athorybia* and *Physophora* stages of *A. elegans*).

Fig. 9ª. View of this knob from below.

Fig. 10. Taster of *A. elegans*.

Fig. 11. Young covering scale of *A. elegans*).

Fig. 12. Adult nectocalyx of the same.

Fig. 13. Young nectocalyx.

Fig. 14. Primitive polypite and tentacle of *Athorybia* stage.

Figs. 15, 16, 17. Stages in the growth of the covering scale.

Fig. 18. Side view of a young nectocalyx older than Fig. 13, turned a little to one end.
 a e. Mantel tube.

Fig. 19. Side view of adult nectocalyx.

Fig. 20. Extruded sacculus of a tentacular knob of adult.
 a. Terminal vesicle.
 b. Terminal filaments.
 c. Sacculus.
 d. Small muscles connecting two extremities of the sacculus.
 e. Retracted involucrum.

Fig. 21. Tentacular knob of the adult *Agalma* with sacculus withdrawn into the involucrum.

Figs. 22, 22ª, 22ᵇ, 22ᶜ 22ᵈ, 22ᵉ. Development of the adult tentacular knob up to the trifid terminal division.

Fig. 23. Very young covering scale.

Fig. 24. Termination (distal) of the taster.

Fig. 25. Optical section of the undeveloped covering scale of *A. elegans*.

PLATE X. *Agalma elegans* (life size).

a. Float.
b. Nectocalyces. *b'*. Undeveloped nectocalyces.
c. Stem.
d. Covering scale.
e. Tentacle. *e'*. Tentacular knob. *j*. Retracted knobs in a bundle.
f. Male bells. *g*. Female bells.
h. Taster.
i. Tentacle of the taster.

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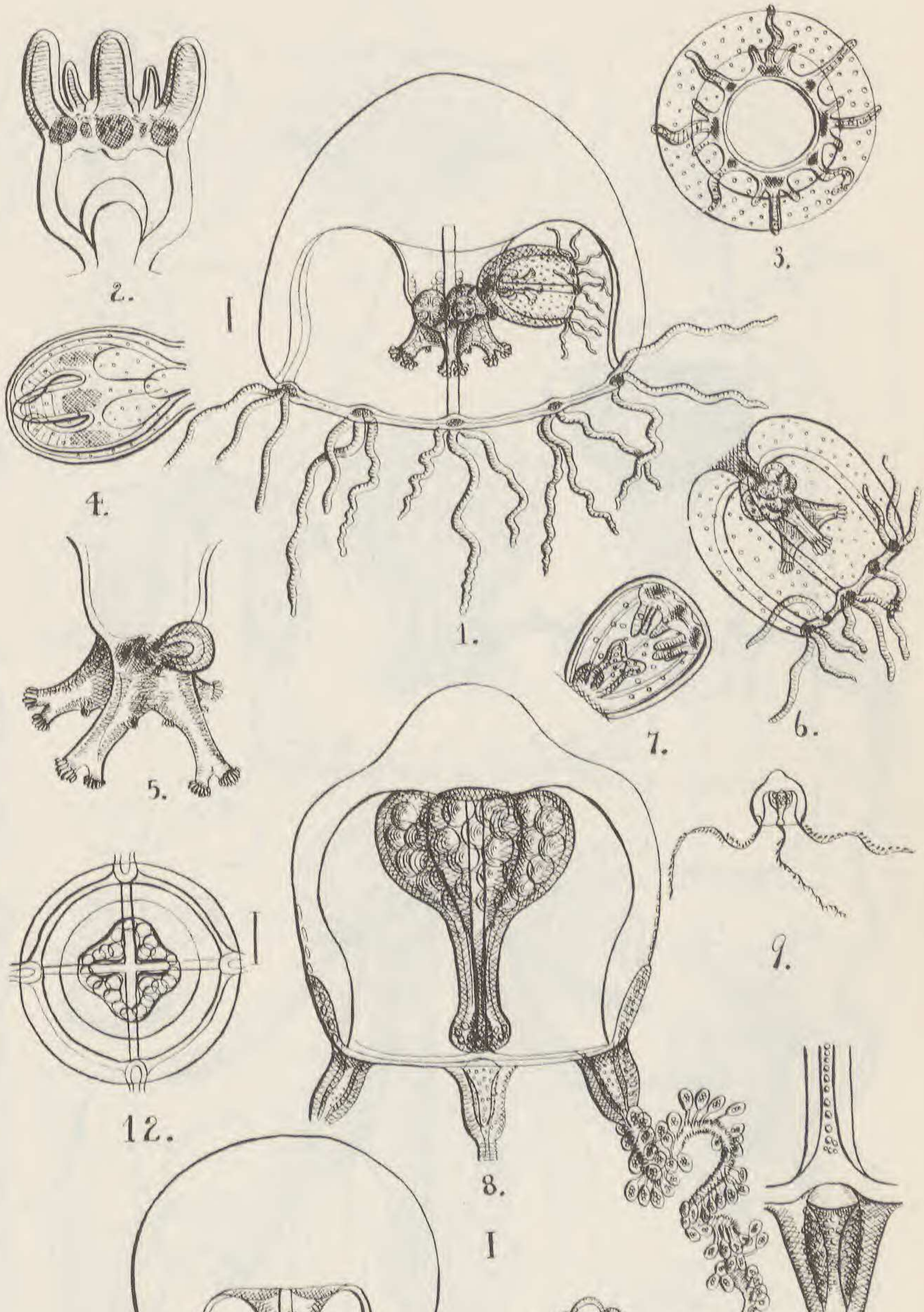

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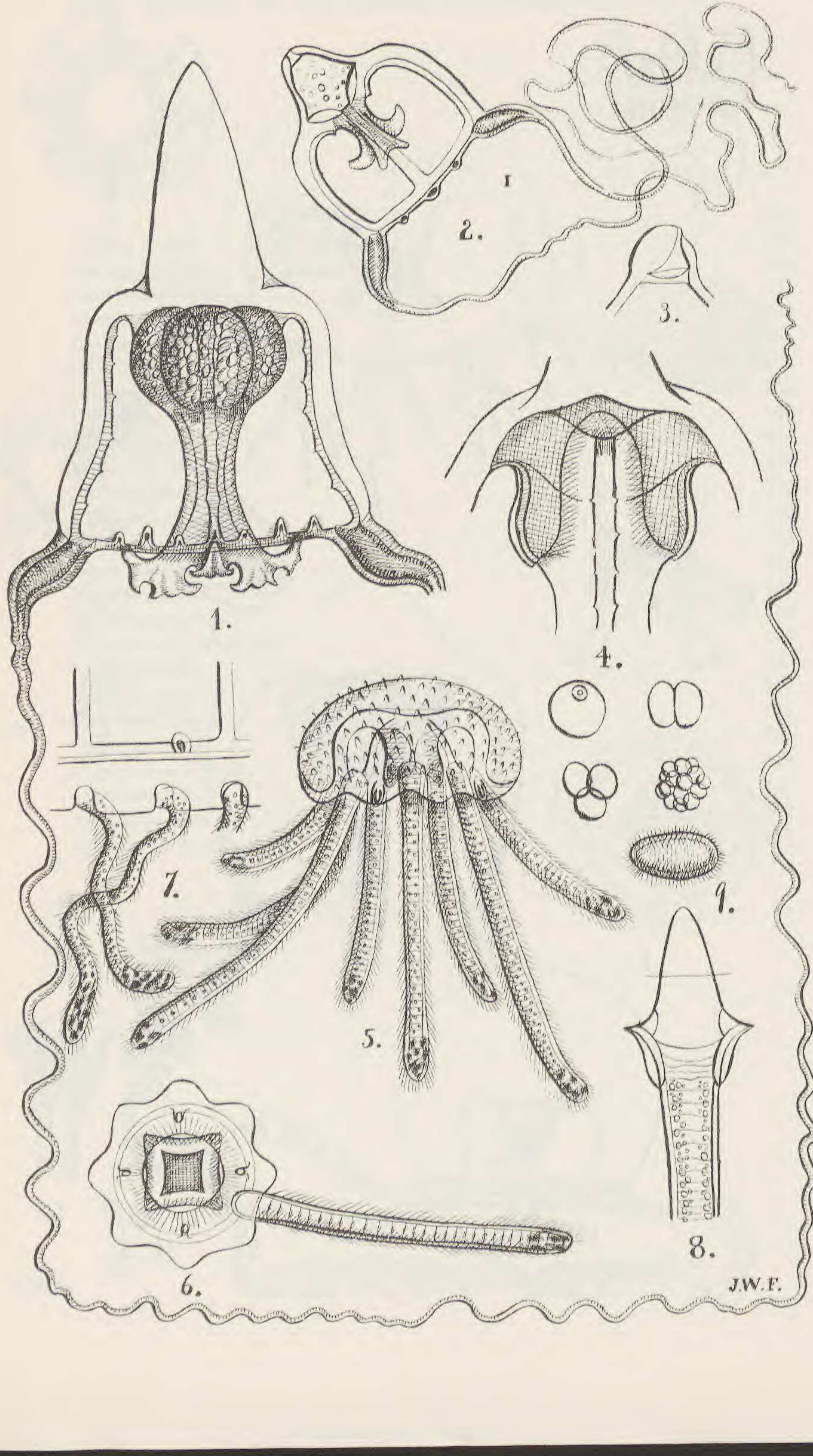
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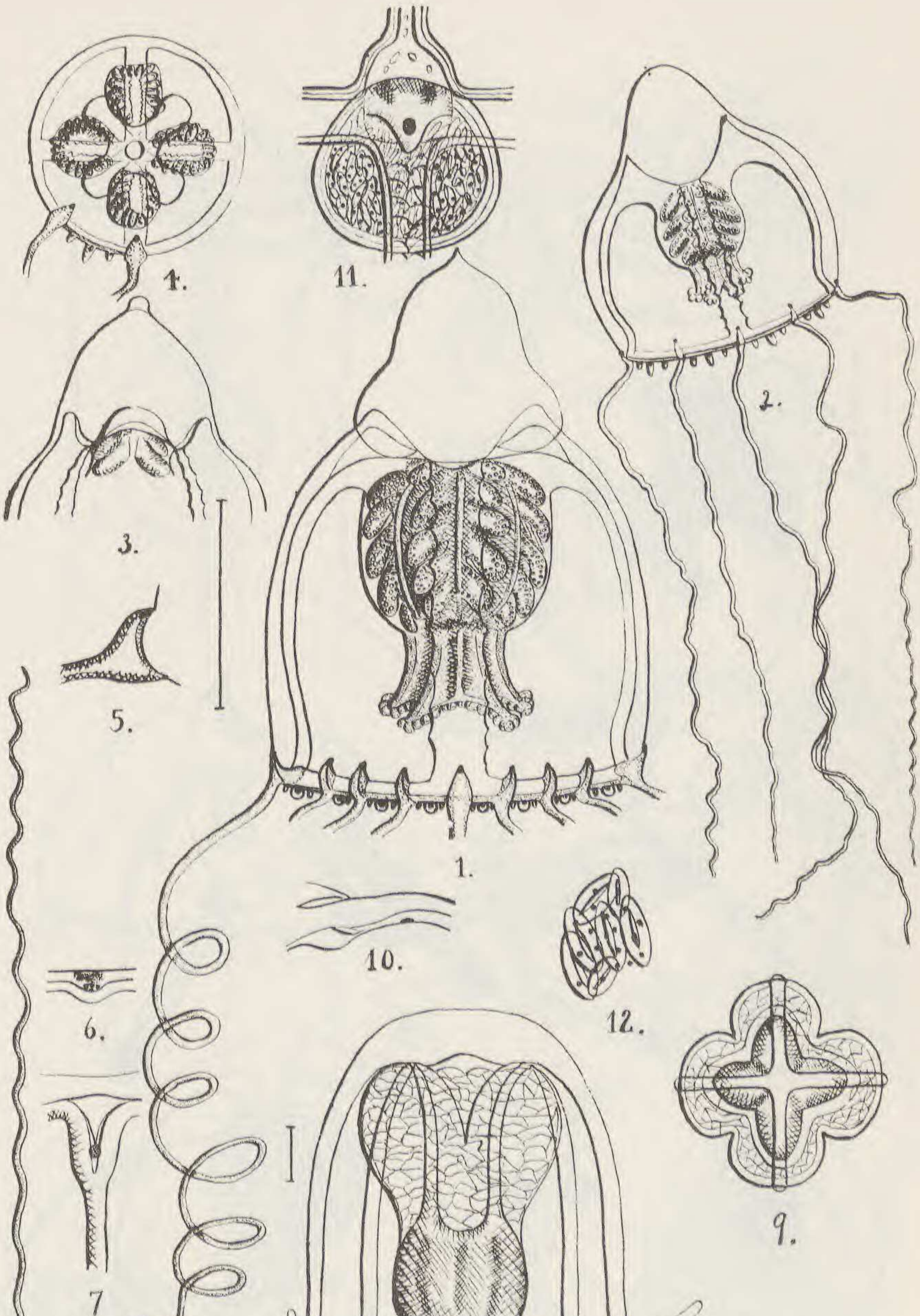

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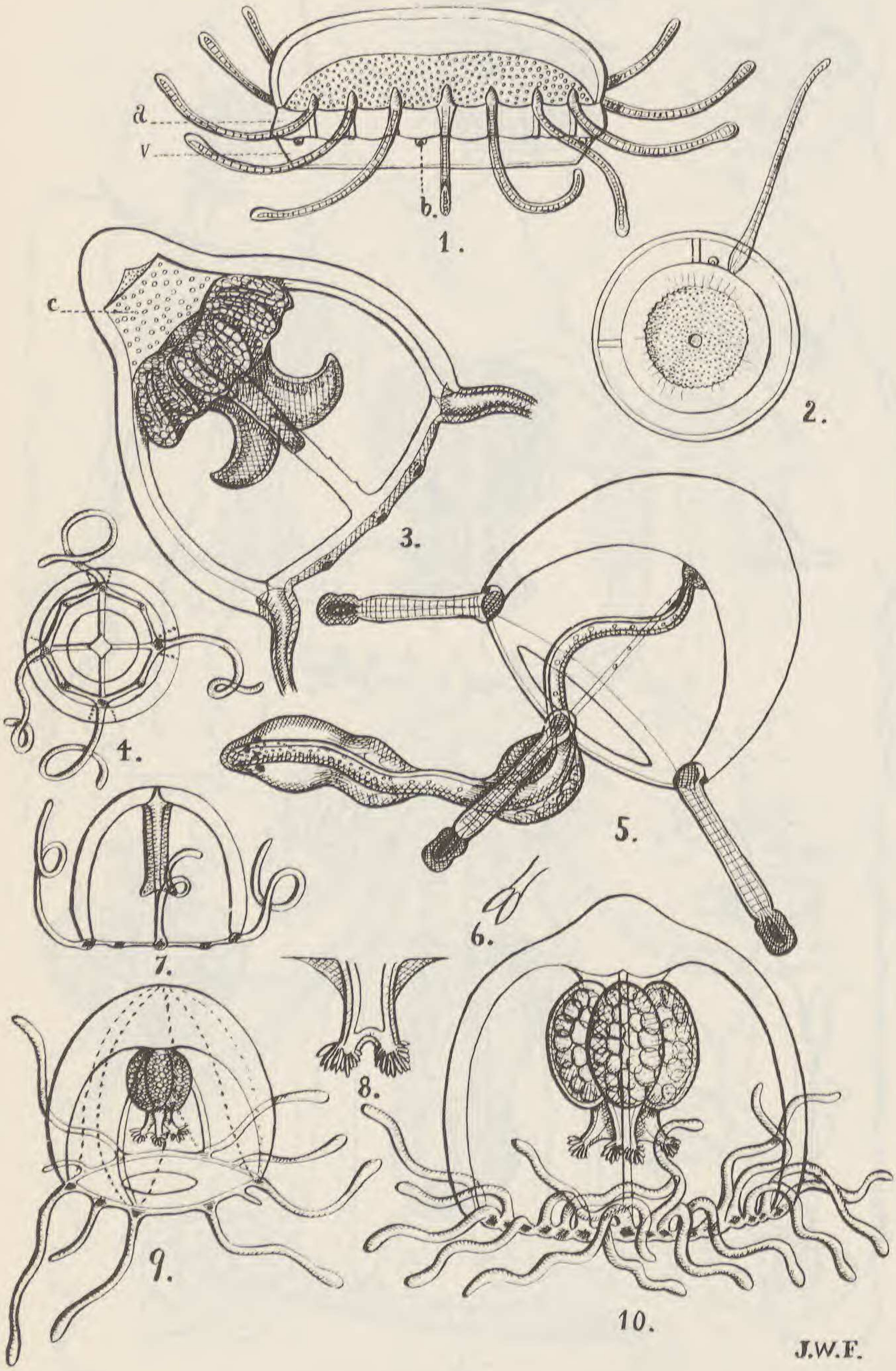
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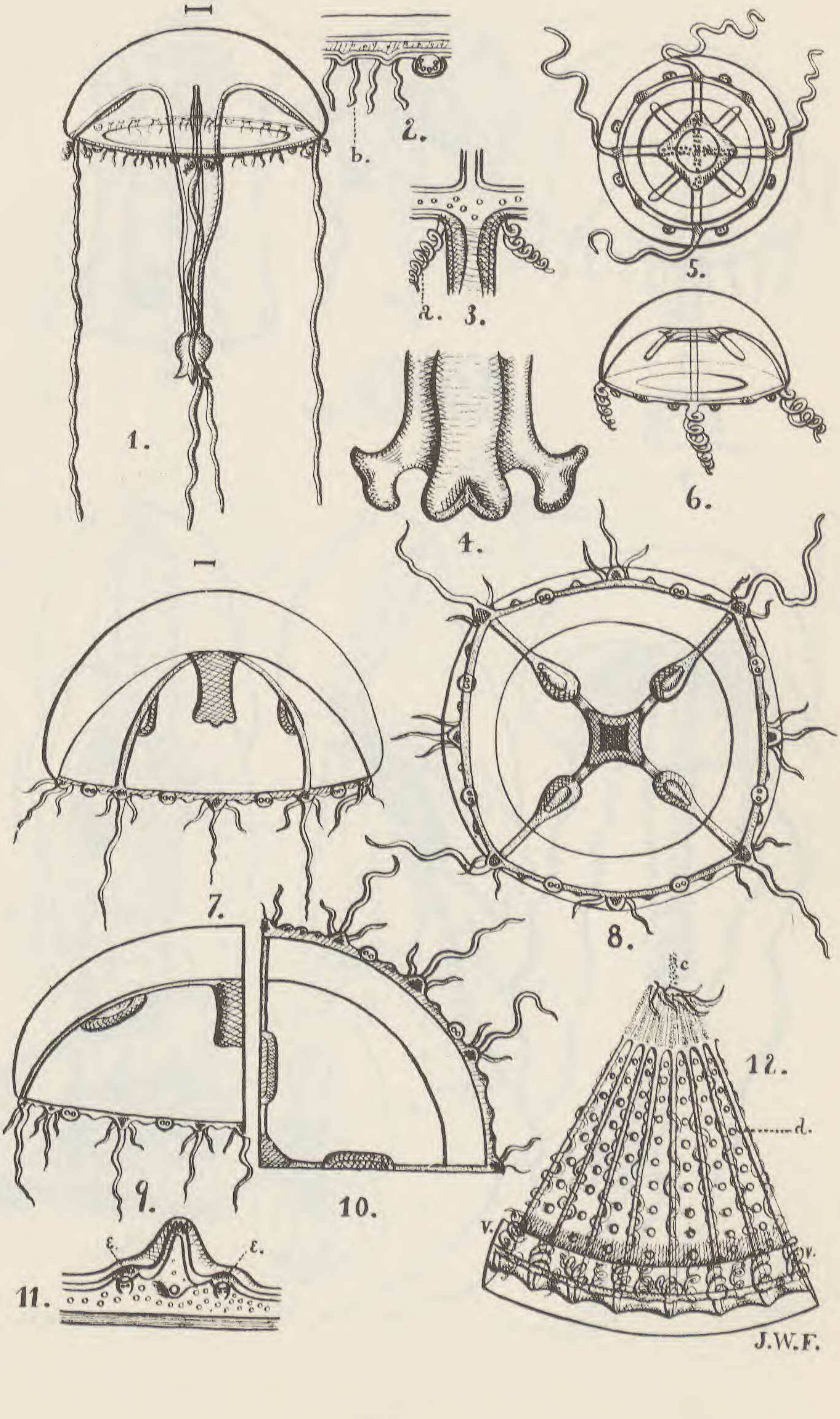
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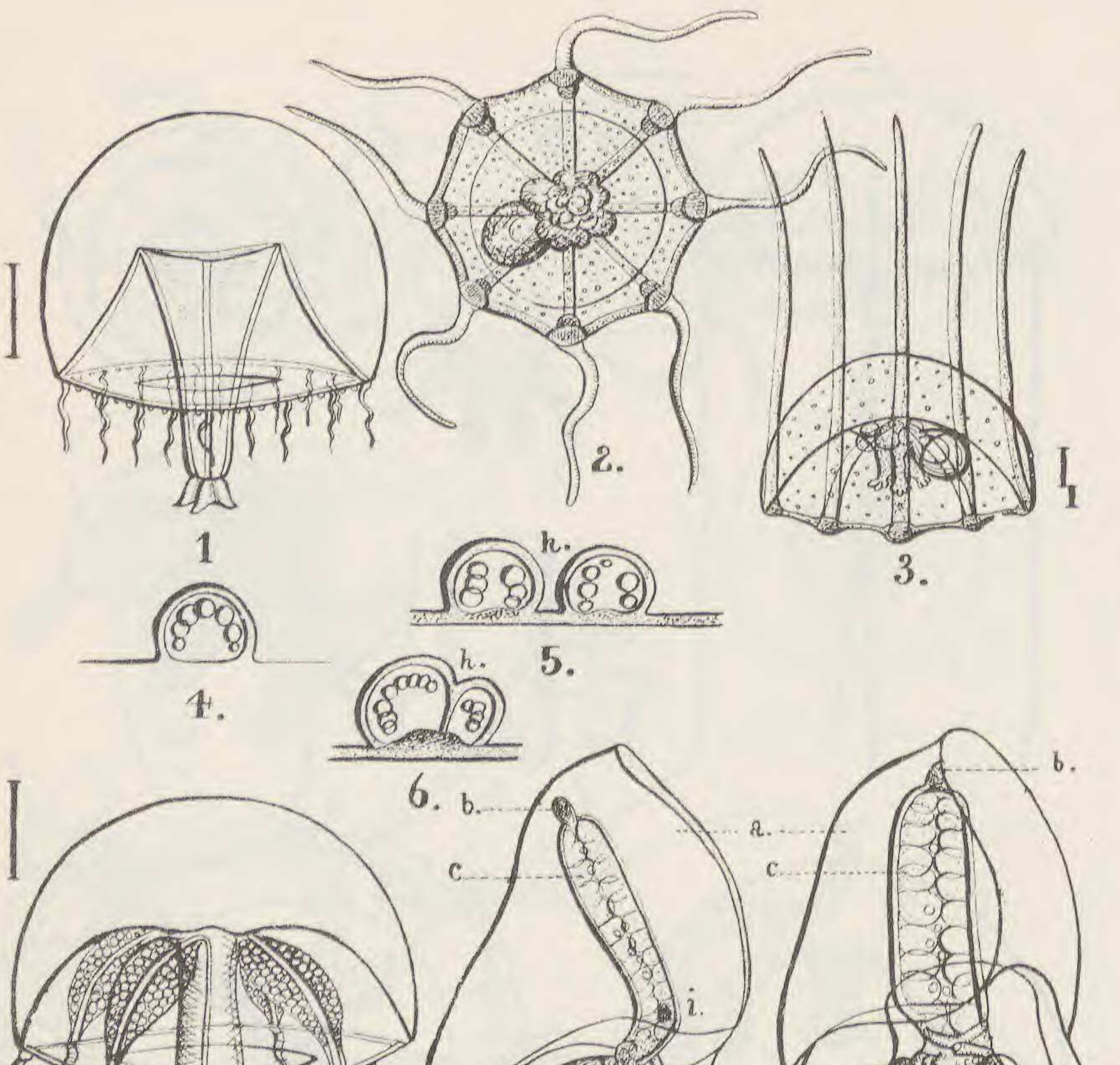
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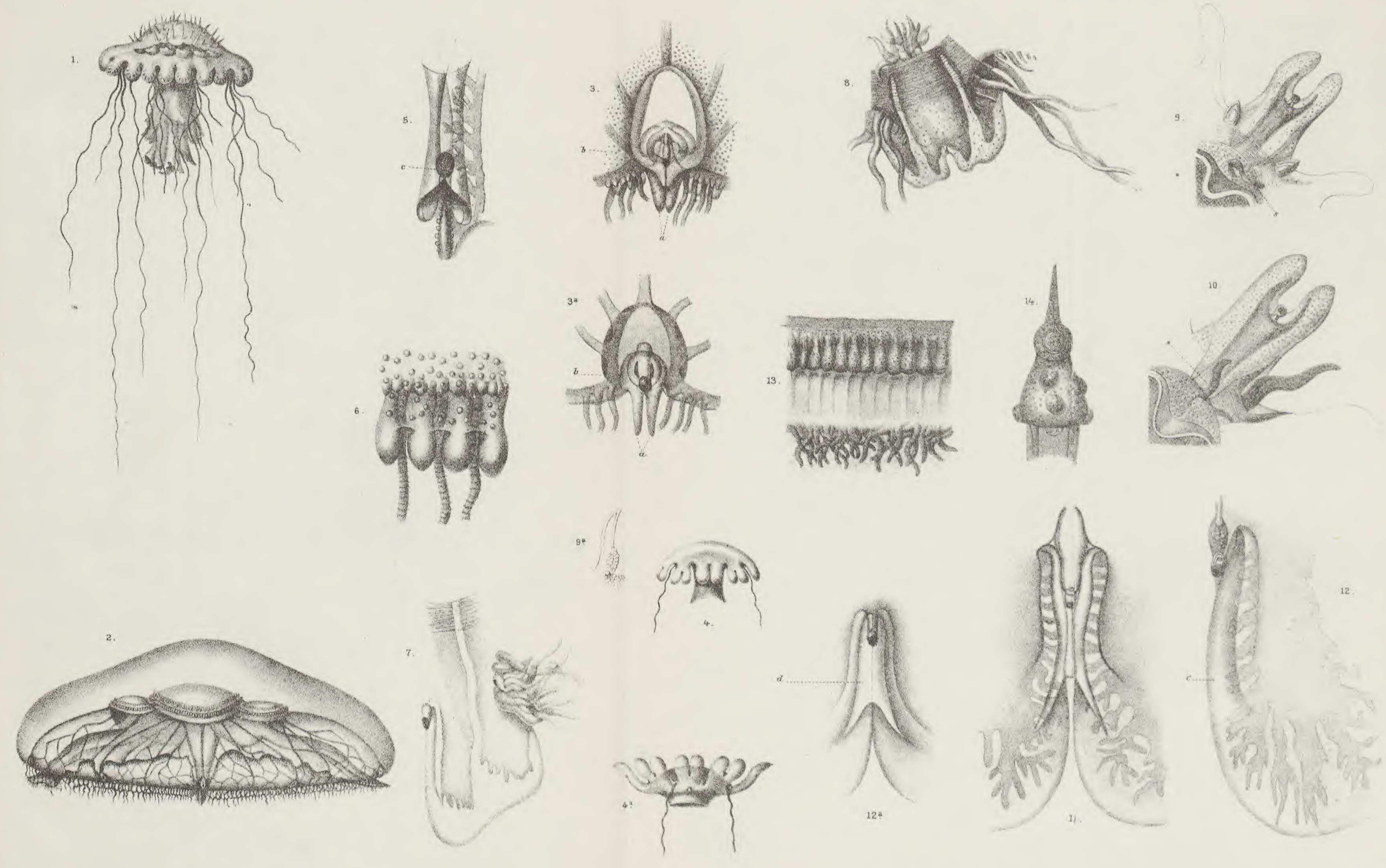

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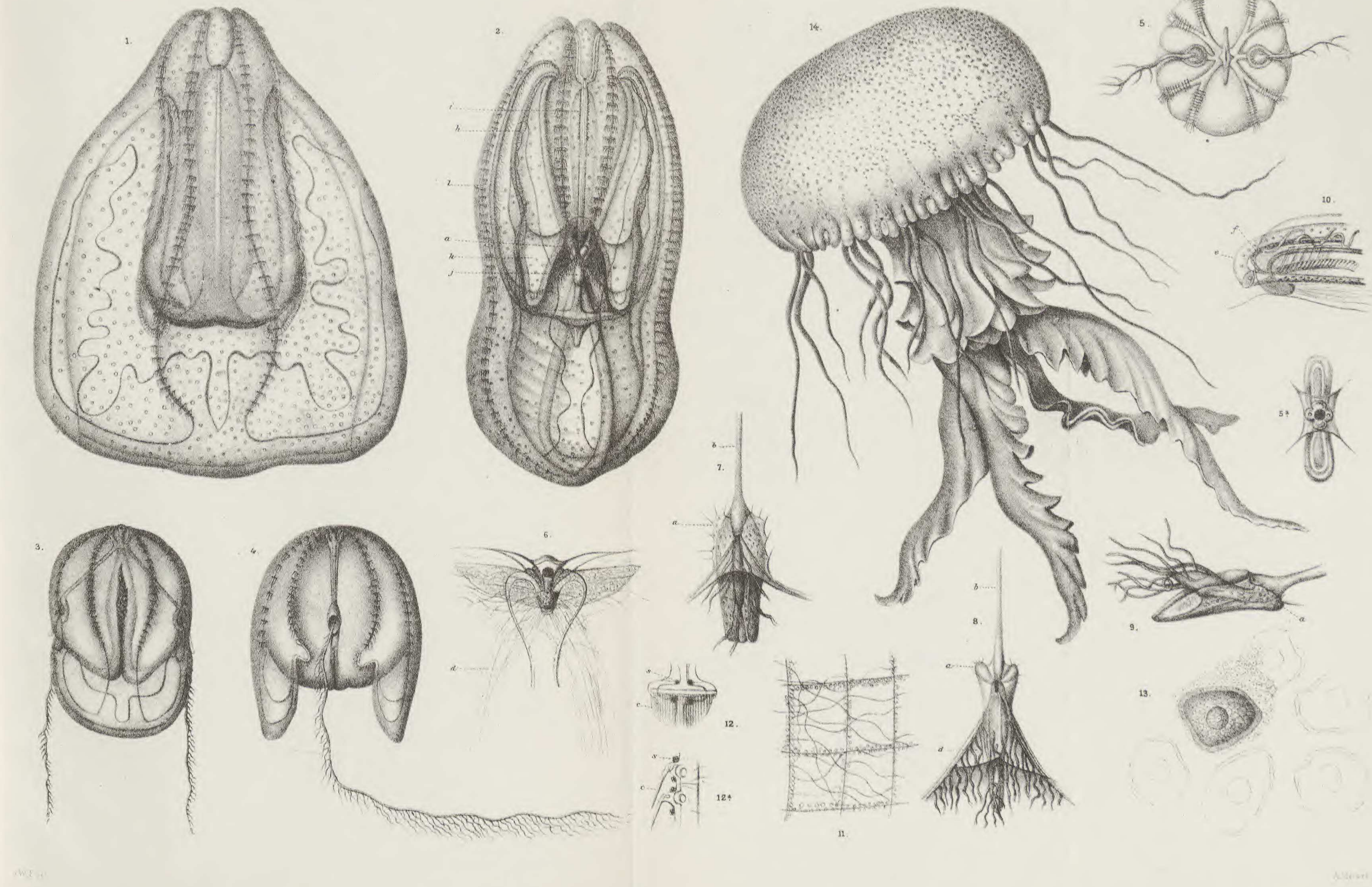
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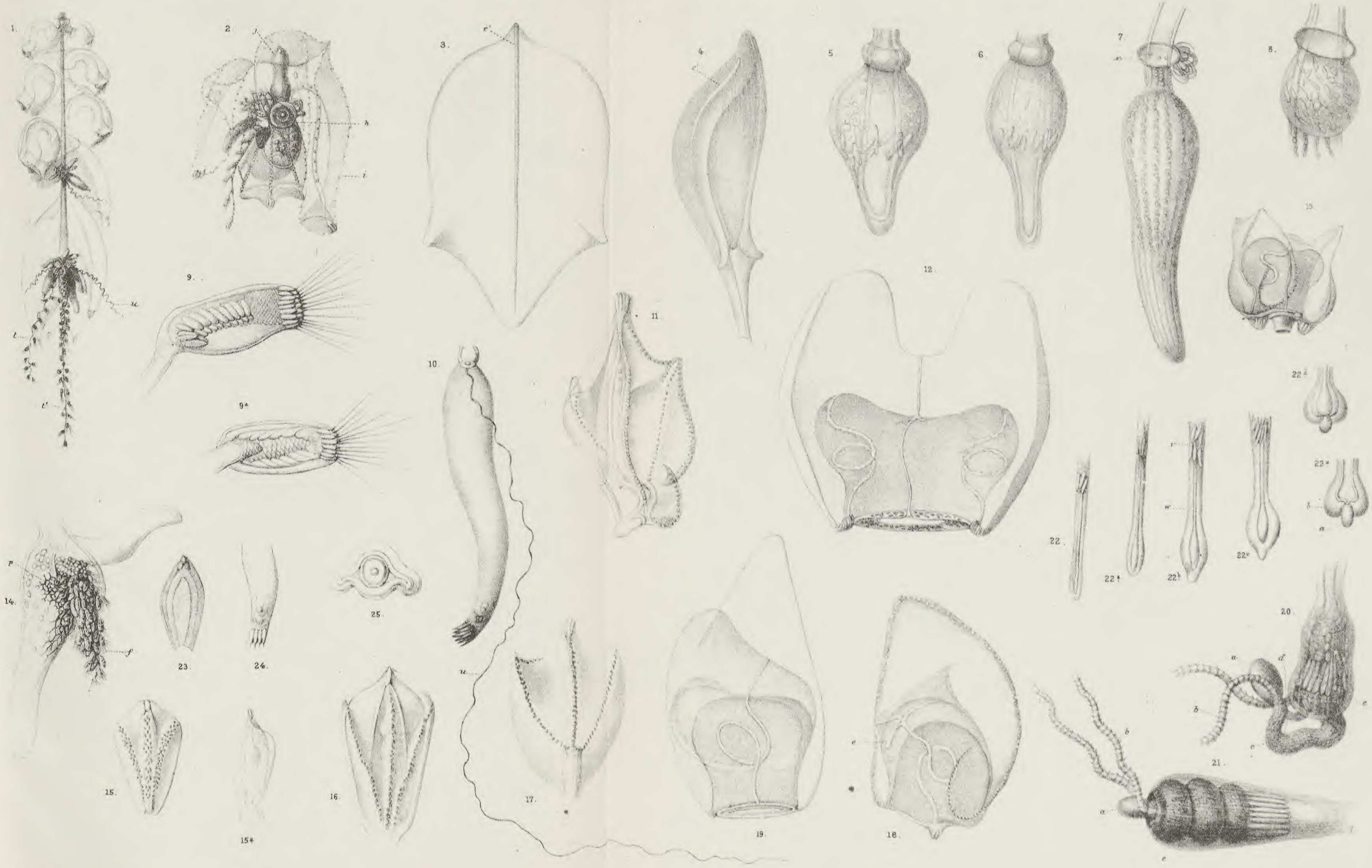
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